# WIRE AND WIRE PRODUCTS

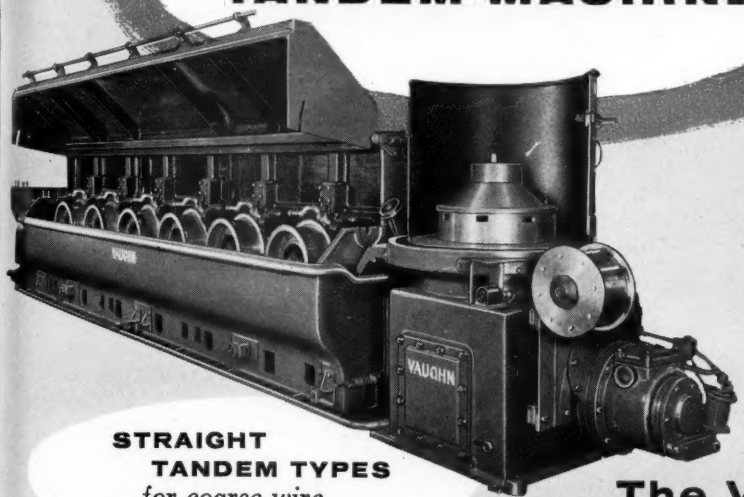
MARCH 1955



*for* **SPEED**
*and* **VERSATILITY**
*in Drawing*
*Non-Ferrous Wire*

**Vaughn®**
**TANDEM MACHINES**

**CIRCULAR TANDEM TYPES**
*for intermediate and fine wire*




**STRAIGHT TANDEM TYPES**
*for coarse wire*

Vaughn Tandem Machines are unexcelled in the high-speed production of aluminum and copper wire and their alloys. Choose circular or straight types according to your requirements—*Vaughn Performance* does the rest!

**The VAUGHN MACHINERY CO.**
CUYAHOGA FALLS, OHIO, U.S.A.

*"Quick on the Draw!"* Ⓥ®

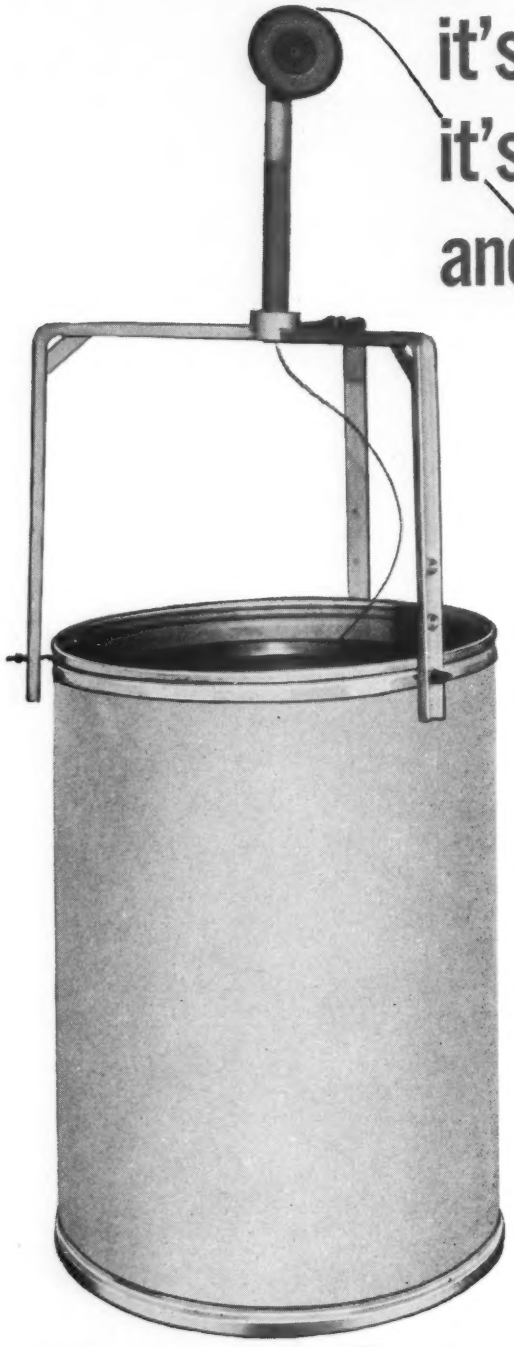
**COMPLETE COLD DRAWING EQUIPMENT . . . . Continuous or Single Hole . . . for the Largest Bars and Tubes . . . for the Smallest Wire . . . Ferrous, Non-Ferrous Materials or their Alloys.**



OFFICIAL PUBLICATION OF THE WIRE ASSOCIATION

# Payoffpak...

## it's new...it's different... it's ideal for handling and processing WIRE!



PAYOFFPAK—Continental's newest fibre container—offers wire manufacturers and fabricators a revolutionary new development in wire packaging, handling and dispensing.

*SAVES WORK*—Wire is automatically packaged in the Payoffpak as it is drawn, eliminating such operations as stripping, tying, handling, splitting and wrapping.

*SAVES TIME*—Payoffpak can hold 600 lbs. Downtime on the wire drawing machine, due to stripping operations, is greatly reduced.

*ELIMINATES REELS*—Single standard-size Payoffpak eliminates reels and need for wide range of block sizes.

*CUTS SHIPPING COSTS*—Inexpensive, light-weight Payoffpaks travel for less because of extremely light tare weight.

*HANDLES AND STACKS EASILY*—In-plant handling of Payoffpaks is easy with conventional hand trucks. High stacking strength means you can use maximum storage space, too.

A survey indicates that often more than 50 labor steps are needed to convert 500 pounds of steel wire in standard eight inch coils—but you can do the same job with Payoffpaks in an average of five operations. No wonder they are calling this new container "the long-playing record of the wire industry" See how Payoffpaks can pay off for you. Call Continental for complete information on this exciting new way to package, handle and dispense wire.

**CONTINENTAL CAN COMPANY**

**FIBRE DRUM DIVISION • VAN WERT, OHIO**

New York • Philadelphia • Pittsburgh • Tonawanda • Cleveland • Chicago
Atlanta • St. Louis • San Francisco • Los Angeles • Eau Claire

"America's Finest
Wire Drawing Lubricants"

Presenting:

# S. I.

SERVICE INCOMPARABLE
SALES INTEGRITY
SOAPS IMPERIAL

>>>NEW<<<

NO. 21-WAX OUTSTANDING IN ITS FIELD

NO. 55 NOT NEW BUT NEVER EQUALLED

Standard Industrial has pioneered in most of the outstanding contributions to better wire drawing through better lubricants. Consult Standard Industrial for the solution of your difficult problems.

NO. 204TS BORAX COATED NAIL STOCK

NO. 230 HIGH SPEED DRAWING and NAIL MAKING

Standard Industrial COMPOUNDS CO., INC.
4600 WEST FERDINAND STREET
CHICAGO 44, ILLINOIS
TELEPHONES: Mansfield 6-9324-5-6

# *Now from* CONTINENTAL

## *Single Length Wire Coils Up to 580 # Catch Weight*

**GET THESE ADVANTAGES WITH OUR NEW HEAVY WEIGHT COILS IN 26" DIAMETER .**

- **CUTS SCRAP LOSS** *50% and More*
- **REDUCES** *Material Handling Costs When using Power Equipment*
- **LONGER** *Continuous Runs*
- **LESS DOWN TIME** *For Production Equipment*

Money-saving comes naturally when you use Continental's new 580# Catch Weight Coils. Longer runs and fewer coils to handle mean faster production because there is less down time. And your scrap loss from coil ends is cut at least in half. The new coils are tightly bound in stout metal straps. Continental specializes in high quality basic open hearth steel wire for thousands of applications in practically any size, temper, finish, shape and analysis in low carbon and medium low carbon steels. Over half a century of wire making assures top service in solving your wire problems. Investigate the new 580# Catch Weight Coil. *It's packaged for profit!*

**PRODUCERS OF** Manufacturer's Wire in many sizes, shapes, tempers and finishes, including Galvanized, KOKOTE, Flame-Sealed, Coppered, Tinned, Annealed, Liquor Finished, Bright, Lead Coated and special wire. Also, Coated and Uncoated Steel Sheets, Nails, Continental Chain Link Fence, and other products.

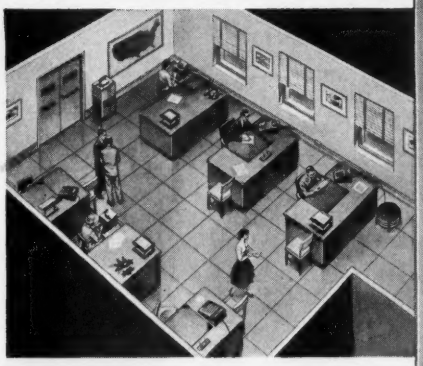
# CONTINENTAL

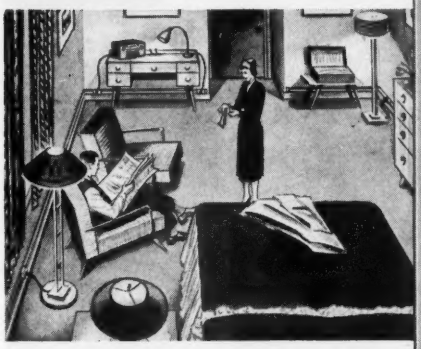
STEEL CORPORATION • KOKOMO, INDIANA

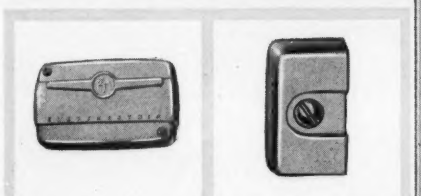
CONTINENTAL STEEL

# a MARVINOL®

## "RIGID" Compound forms and insulates BullDog's new ELECTROSTRIP*







ELECTROSTRIP is a new flexible, plastic strip containing two concealed electric wires. Individually-fused receptacle plugs can be snapped into place, instantly, anywhere along its length. This eliminates long, dangerous extension cords and multiple plugs. Installed unobtrusively around the walls or baseboards of a room, office, display area, shop or store, ELECTROSTRIP brings power conveniently to lamps, home appliances, office machines, small tools, and other small electrical units up to a total of 20 amps.

Naugatuck supplies the MARVINOL "Rigid" (non-plasticized) vinyl compound which has proved ideal for this new product because:

- MARVINOL resins form a tough, strong strip which can be bent by hand to fit wall contours and turn corners.
- "Rigid" MARVINOL compounds are far superior to soft or plasticized vinyls in electrical insulating properties. ELECTROSTRIP is listed by Underwriters' Laboratories, Inc.
- The built-in color and smooth, attractive surface produced by MARVINOL resins provide a ready-made, permanent finish which can be painted over if desired.

MARVINOL resins provide compounds with extreme dimensional stability plus a controllable degree of flexibility. They are non-flammable and highly resistant to heat, oils, acids, alkalies and ozone...can be made either transparent or opaque. If you have in mind a new or improved product requiring any or all of these properties, be sure to consult with us about MARVINOL "Rigid" vinyls.

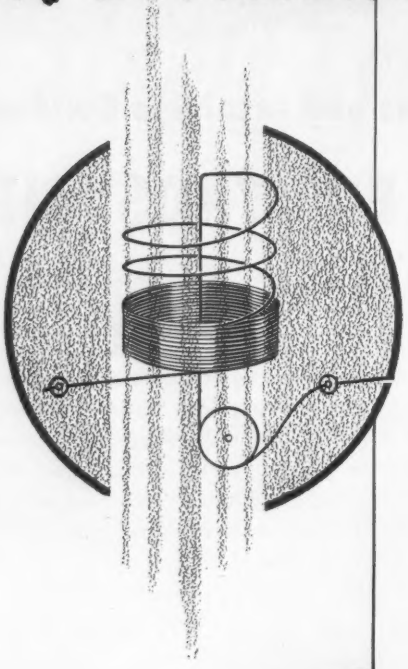
*Reg. & mfd. by BullDog Electric Products Co., Detroit

Naugatuck Chemical

Division of United States Rubber Company
Naugatuck, Connecticut

BRANCHES: Akron • Boston • Charlotte • Chicago • Los Angeles • Memphis • New York • Philadelphia • IN CANADA: Naugatuck Chemicals, Elmira, Ontario
Rubber Chemicals • Synthetic Rubber • Plastics • Agricultural Chemicals • Reclaimed Rubber • Latices • Cable Address: Rubexport, N.Y.

# AIR Efficiently Applied...



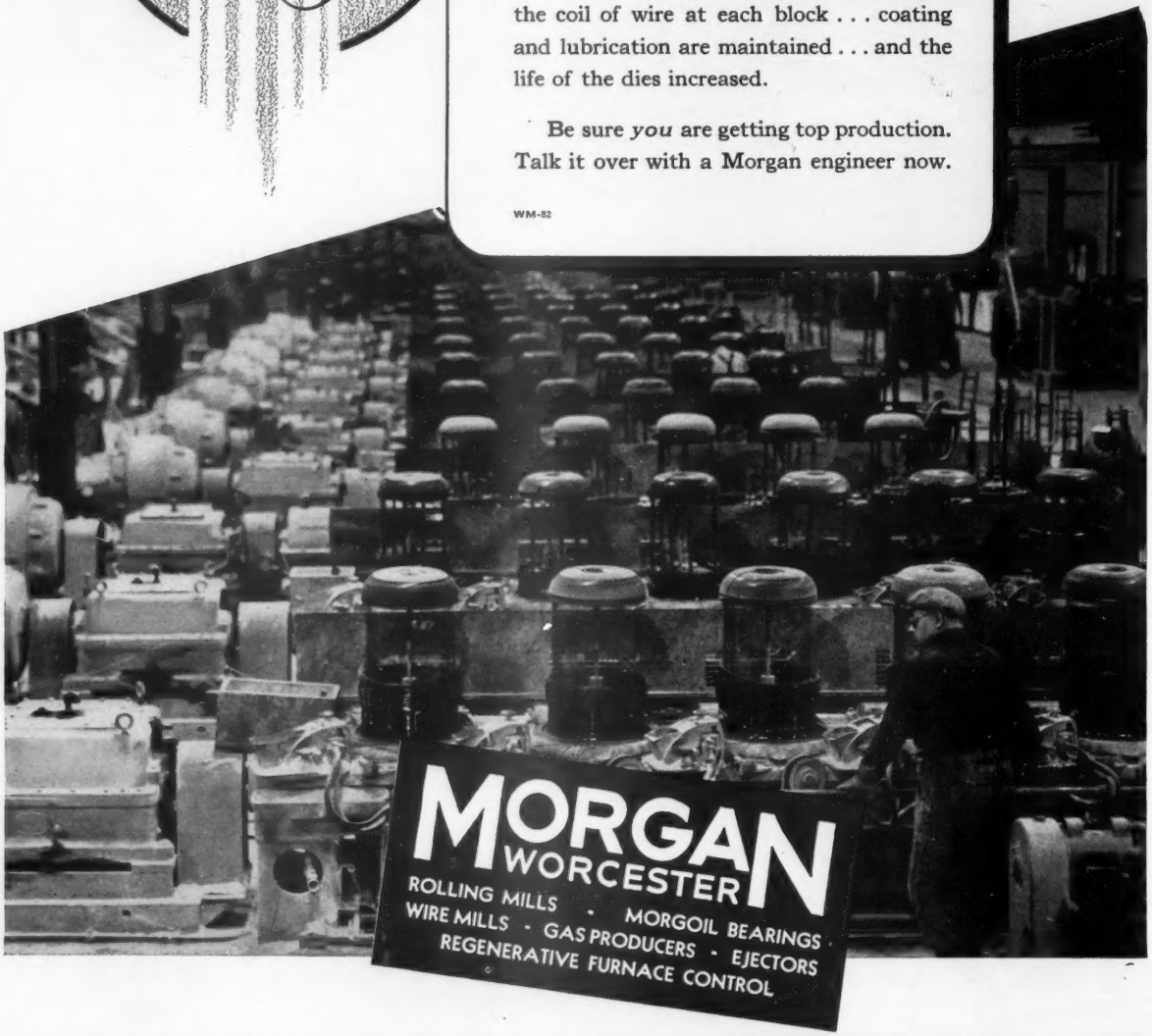
## keeps these MORGAN-CONNORS producing at high speeds

Because of this fast and efficient air cooling high carbon wire can be drawn at high speeds, and meet the most exacting physical specifications.

Air is blown *up through* and *around* the coil of wire at each block . . . coating and lubrication are maintained . . . and the life of the dies increased.

Be sure *you* are getting top production. Talk it over with a Morgan engineer now.

WM-82




MORGAN CONSTRUCTION COMPANY • WORCESTER, MASSACHUSETTS

# WIRE AND WIRE PRODUCTS*

Reg. U. S. Pat. Off.

A monthly publication devoted to the production of Wire, Rod and Strip, Wire and Rod Products and Insulated Wire and Cable.

DRAWING — ROLLING — EXTRUDING — FORMING — FABRICATING

Vol. 30 March, 1955 No. 3

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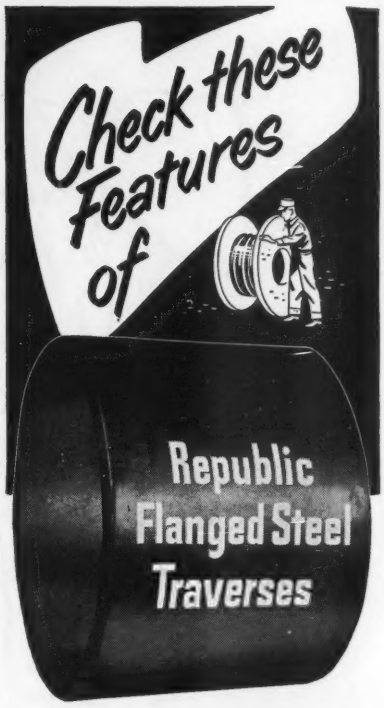


**1. Light Weight**

**2. High Strength**

**3. Top Durability**

**4. Easy to Assemble**

**5. Smooth Galvanized Surface—no rough spots to damage plastic-covered cable**

● Made in sizes up to 56-inch diameter and 48-inch traverse—in plain, painted or hot dip galvanized finish—as light as 18-gauge steel. Width of flange and number of bolt and drain holes furnished to your specifications. Available for prompt delivery. Write for prices.

* * *

*Manufactured under license arrangement with Western Electric Co., Inc.*

REPUBLIC STEEL

**REPUBLIC STEEL CORPORATION**
*Pressed Steel Division • Niles, Ohio*
GENERAL OFFICES • CLEVELAND 1, OHIO
Export Dept.: Chrysler Building, New York 17, New York

# Story of a contractor who lost his shirt

**(or why use ELGIN Diamond)**

Once upon a time there was a contractor. He was a good contractor. He worked hard, knew his business, did all the things that help pile up the bucks. This contractor built houses, hotels, highways, anything . . . and that meant concrete. Why, he used so much concrete it just wasn't funny.

One day, a salesman from a new kind of company called on our contractor and tried to sell him "ready-mixed" concrete.. "Ready-mixed" concrete . . . now wasn't that a silly thing? Why, he'd been mixing his own concrete for nigh onto 20 years. Why change now? "Ready-mixed" . . . ridiculous.

Well, as it happened, the same salesman called on some of Mr. Contractor's competitors and they thought "ready-mixed" concrete was great, tremendous, terrific. They found there was no waste, it was convenient and even saved them money. It wasn't long before friend contractor lost his shirt. Sad? Yes . . . if only he had *tried* "ready-mixed".

Today, there's a "ready-mixed" type of diamond abrasive on the market called Elgin Diamond. Lots of companies use it—some don't. Those that do have found that with Elgin Diamond there's no bothersome mixing or special grading, no costly waste or chance for error. They also found that because diamond particles are permanently suspended in a specially formulated, color-identified vehicle, they get consistent polishing results.

We're not saying you'll lose your shirt if you don't use Elgin Diamond. We are saying you owe it to yourself and your company to try Elgin Diamond. You can get all the facts by writing.

ABRASIVES DIVISION

Dept. G

**ELGIN NATIONAL WATCH COMPANY**

ELGIN, ILLINOIS

Amazing how many different products are made from Chase copper alloy wire! Everything from strainer cloth to cold-formed nuts. Yet, no matter *what* the final product, or *how* it is made, Chase wire makes it *better!*

You don't get *ordinary* copper alloy wire from your nearby Chase warehouse. For Chase copper alloy wire is the cleanest, best-tempered, easiest-to-work wire you ever used.

First of all, we take pains to give you the ideal alloy for your specific needs. We test and re-test to make sure every shipment comes up to our strict quality standards.

Finally, we deliver Chase wire to you perfectly "cast," so it uncoils uniformly, without twisting or tangling.

Speaking of delivery, you can always expect super-prompt service from Chase. Streamlined order handling is standard Chase procedure—whether you order one small coil or a hundred.

Contact your nearby Chase warehouse. Try Chase copper alloy wire. Try Chase service. You'll like both.

CHASE NOW SELLS
STAINLESS STEEL, TOO!

# Chase

BRASS & COPPER CO.

WATERBURY 20, CONNECTICUT • SUBSIDIARY OF KENNECOTT COPPER CORPORATION

*The Nation's Headquarters for Brass & Copper*

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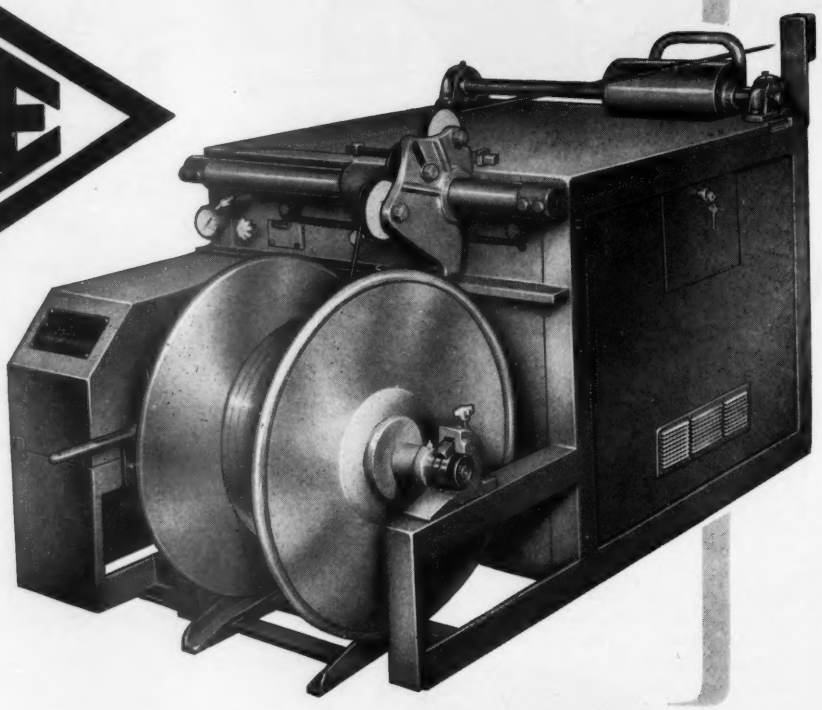
# INDIVIDUAL DRIVE– BRAKE–and–TRAVERSE

## RE-SPOOLERS



Standard Class O Re-Spooler

**Gang winders are out of date!** Replace them with JLE's individual drive Re-Spoolers to improve the quality of your wire rope or strand through uniformly wound strander spools. You'll be astonished at the low cost of such high quality machines.

**Class O Re-Spoolers will give you:**

Adjustable 3-to-1 range of spool speed for economical winding of varying wire sizes.

Traverse providing infinite adjustment for wire diameter and spool width, resulting in ideal wire lay.

Rear feed roll.

Forming rolls to form the wire.

Pneumatic braking for quick, smooth stops. No overruns!

Each wire start can easily be made at spool flange.

Totally enclosed motor drive in rugged, fabricated-steel frame.

JLE Re-Spoolers are available for several spool sizes and horse power ratings.

**Ask for Catalog Section 3B**

**JAMES L. ENTWISTLE CO.**

*PLANT and EXECUTIVE OFFICE:*

**1475 ELMWOOD AVE., CRANSTON (PROV. 7), R.I., U.S.A.**

*FOR THE SHAPE(S) OF THINGS TO COME . . SEE . . .*

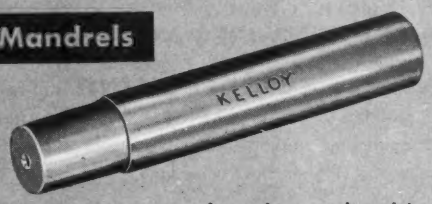
# "KELLOY" CARBIDE SHAPE DIES

A die shaped to wire manufacturers specifications, enabling him to satisfy the most exacting customer, demands a combination of experience and engineering not readily available in the average tool room.

That combination of experience and engineering is as much a part of Kelloy as the famous Firthaloy rough cores used in actual production.

The satisfaction of Kelloy performance can be yours too. Our engineering staff is available to assist you with your drawing problems. Simply write or telephone for price list or information.

**Mandrels**




The same exacting workmanship employed in Kelloy shape dies, assures the superior carbide mandrel for your every tubing requirement.

Authorized distributors and finishers of FIRTH STERLING die materials

**KELLOY** CORPORATION

**30 WEST 35th. STREET • NEW YORK 1, N. Y.**

# Fastest Process Annealing FOR COILED STEEL WIRE

- ✓ Annealing cycles accomplished in minutes rather than in hours
- ✓ 50% lower equipment cost
- ✓ less floor space
- ✓ no scale, decarburization, or other atmosphere effects

On-the-job production figures prove that no other method compares with an Ajax Electric Salt Bath Furnace in speed, uniformity, cost saving, and general all-around efficiency in process annealing all types of steel wire as well as aluminum, copper alloys, and silver alloys.

Heating cycles are far faster. Absolute uniformity is assured. Thanks to the exclusive Ajax electrodynamic stirring action, the temperature does not vary more than ±5°F. *in any part of the bath.*

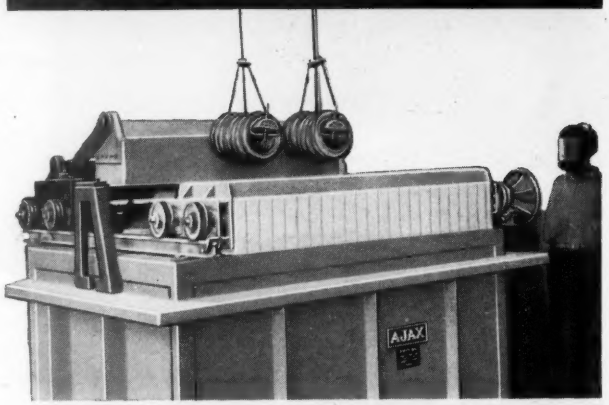
The Ajax Salt Bath eliminates all atmosphere with its accompanying problems of oxidation, pitting, and decarburization. Preservation of metal surface is assured. Equipment cost is much lower —and the Ajax handles more work for a given amount of floor space than any other method. Ajax Reprints 62 and 63 gladly sent on request.

**LOW- AND HIGH-CARBON STEELS**

This typical Ajax installation process anneals 1200 lb. 18-gauge wire an hour in only 58 feet of floor space.

**STAINLESS STEEL**

Annealing fine gauge nickel-chromium wire at 1950°F. Clean wire surface eliminates conventional pickling operations.




- **TOPS for WIRE PATENTING, too!**
- **IDEAL FOR DESCALING** hot-rolled stainless and alloy steel wire and other shapes employing either the Dupont sodium hydride or the Hooker Electrochemical Virgo bath.

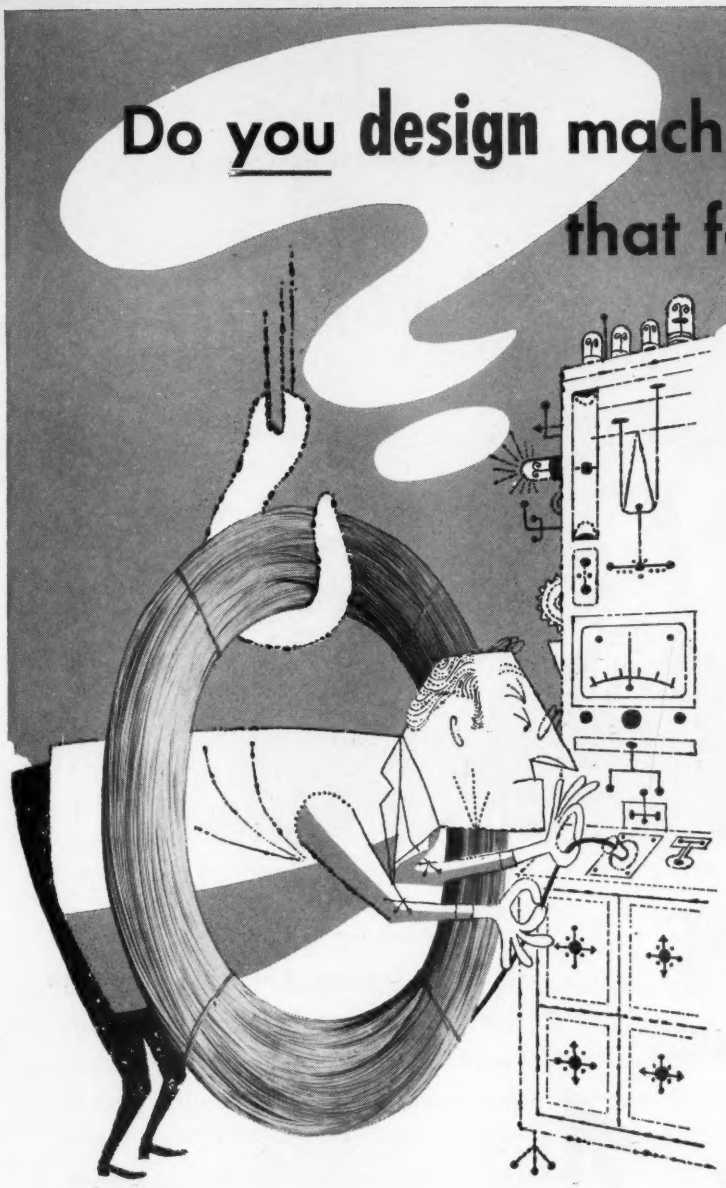
Associate companies: Ajax Electric Furnace Corp. • Ajax Engineering Corp. • Ajax Electrothermic Corp.

# AJAX electric SALT BATH furnaces

OVER 4,000 INSTALLATIONS . . . more than all other salt baths combined

**AJAX ELECTRIC CO., Inc., 928 Frankford Ave., Philadelphia 23, Pa.**

# Do you design machinery that fabricates wire?



The design of Wire Fabricating machinery is one of the most rigorous engineering assignments you can get. But no matter how tricky the problems, do not forget the front end of the machine—where you actually load the wire.

We have been amazed, for example, to learn that certain customers have been buying non-standard coils of wire for years, thinking that they were *standard* coils. Naturally, there is a shipping delay due to not being able to use standard material.

Here's an offer: If you contemplate the design of any wire fabricating equipment, get in touch with your American Steel & Wire representative first. Let him bring you up to date on the latest wire industry standards—and show you how to design the equipment to use the most economical types and sizes of wire coils. He will also be glad to help you lay out your wire storage and handling facilities. The result will be lower costs and faster delivery and better production using your newly designed equipment.

**USS AMERICAN MANUFACTURERS WIRE**

**AMERICAN MANUFACTURERS WIRE**

**AMERFINE**—*High quality fine wire.*

**AMERSPRING**—*music steel spring wire.*

**AMERLOY**—*alloy heading wire.*

**AMERTEMP**—*heavy-duty oil-tempered wire.*

**AMERHEAD**—*uniform heading wire.*

**AMERSTITCH**—*extra-tough metal stitching wire*

USS

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UNITED STATES STEEL

It can't be done

WE'VE DONE IT!

# DURPON*

## WIRE-DRAWING COMPOUNDS

*last twice as long... yet cost no more!*

**We realize we're claiming a lot for Nopco Durpons. Perhaps the only men who believe it are the men who use Durpons. But they are the ones that matter.**

There are two sound reasons for Durpon's profitable performance: All Durpon compounds contain: (1) a buffer, to maintain the pH level, keep the emulsion from breaking; (2) a sequestering agent, which holds the metal particles away from the effective drawing ingredients, *keeps the bath clean.*

Won't you be the next to try these high-performance compounds, and learn first-hand the economies they bring? Write today for technical bulletin and free working sample.

Nopco Chemical Co.,
336 Industrial St., Harrison, N. J.

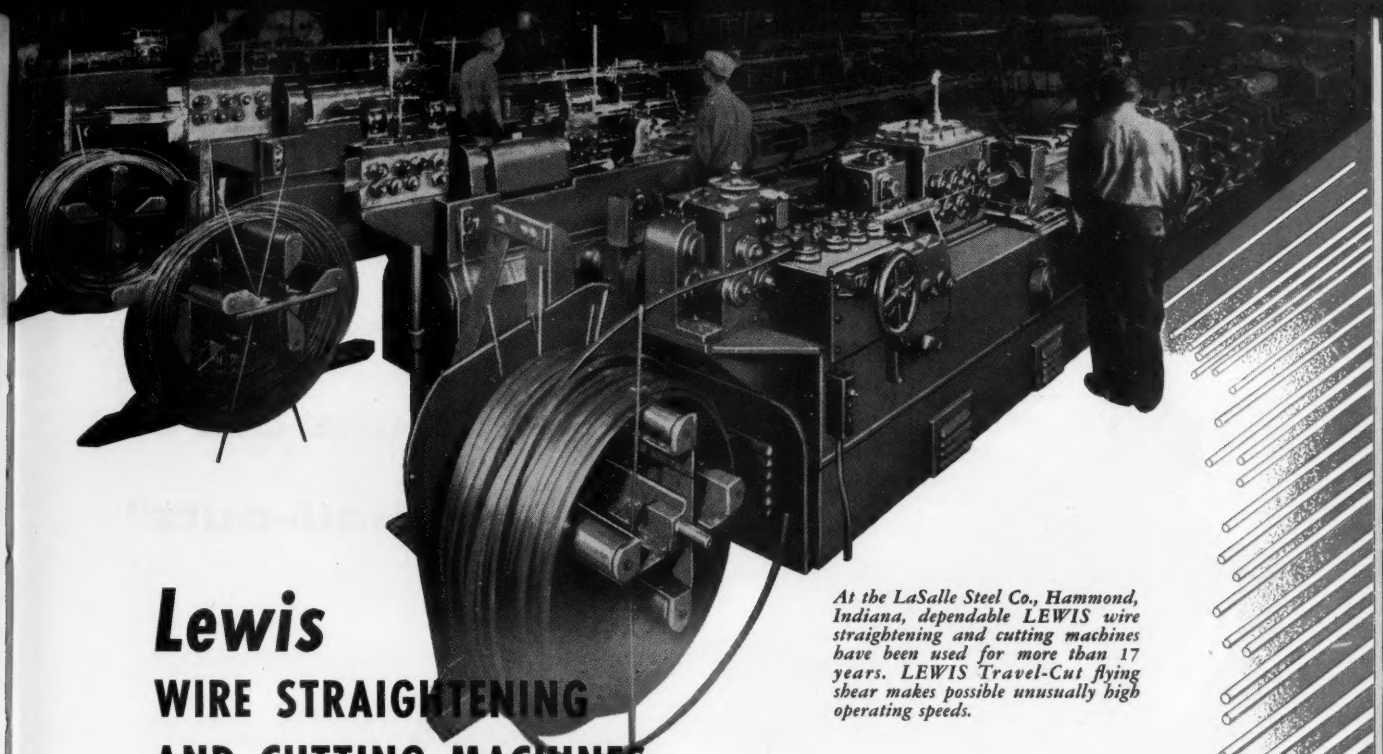
***"Stay Stable Longer"***

**DURPON**—for intermediate gauge wire
**DURPON L**—for heavy wire, rods, and tubes
**DURPON FW**—for fine wire

NOPCO

*Reg. U.S. Pat. Off.

PLANTS: Harrison, N. J. • Cedartown, Ga. • Richmond, Calif.



*At the LaSalle Steel Co., Hammond, Indiana, dependable LEWIS wire straightening and cutting machines have been used for more than 17 years. LEWIS Travel-Cut flying shear makes possible unusually high operating speeds.*

# *Lewis*
# WIRE STRAIGHTENING AND CUTTING MACHINES

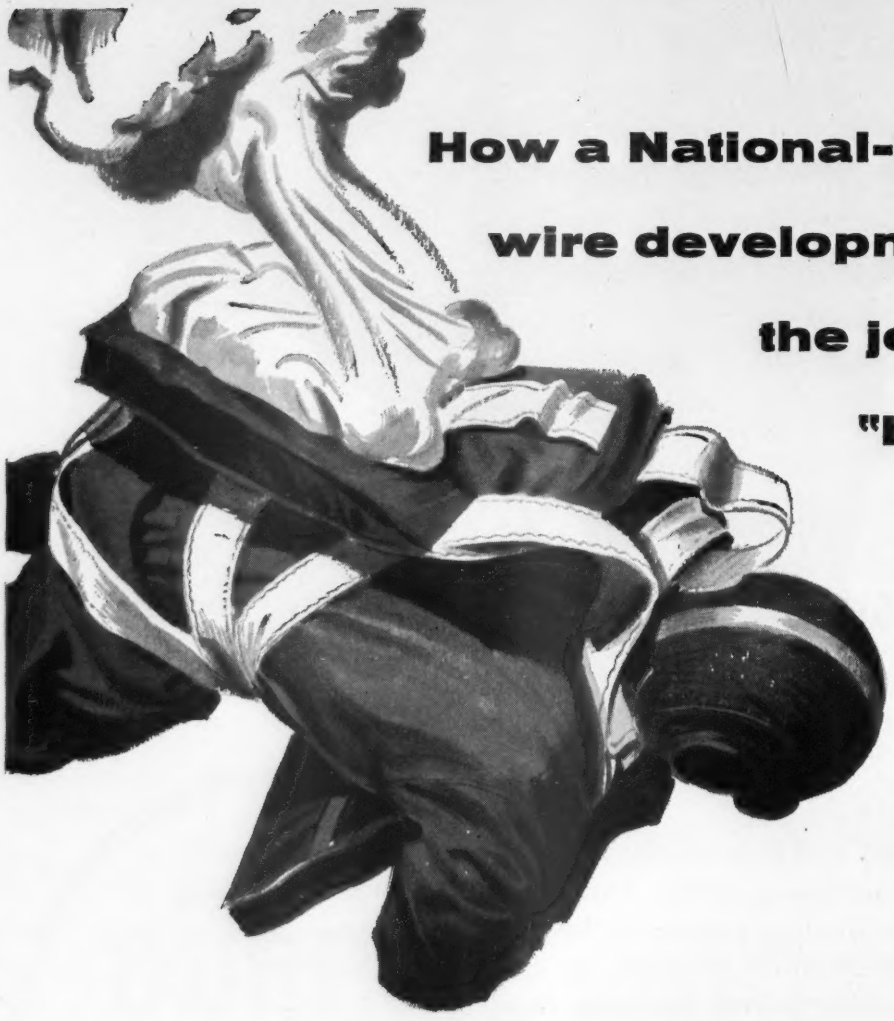
*... preferred by leading manufacturers and suppliers of wire and wire products for continuous high-speed production*

Companies like *LaSalle Steel* build their business on a reputation for top-quality products and prompt service. That is why LEWIS wire straightening and cutting machines have been preferred by leading manufacturers and suppliers of wire and wire products for over 40 years. LEWIS offers a *complete* line of machines for every production requirement — 23 models for wire from .012″ to 3/4″. Famous LEWIS *Travel-Cut* flying shear makes possible continuous production of perfectly straightened and cut wire at unusually high operating speeds. Many other time-tested exclusive LEWIS features make the LEWIS line of wire straightening and cutting machines unequalled for high speed, low cost wire and wire products production.

*Write, wire or call today for information on LEWIS wire straightening and cutting machines for wire from .012″ to 3/4″, including the LEWIS Travel-Cut for continuous high-speed production*

## THE LEWIS MACHINE CO.

**3447 EAST 76th STREET**
**CLEVELAND 27, OHIO**



# How a National-Standard wire development took the jolts out of "bail-outs"

● Until recently, when a pilot "hit the silk", the shock was almost more than his frame could absorb. A better parachute harness was needed.

A leading spring maker brought this problem to National-Standard.

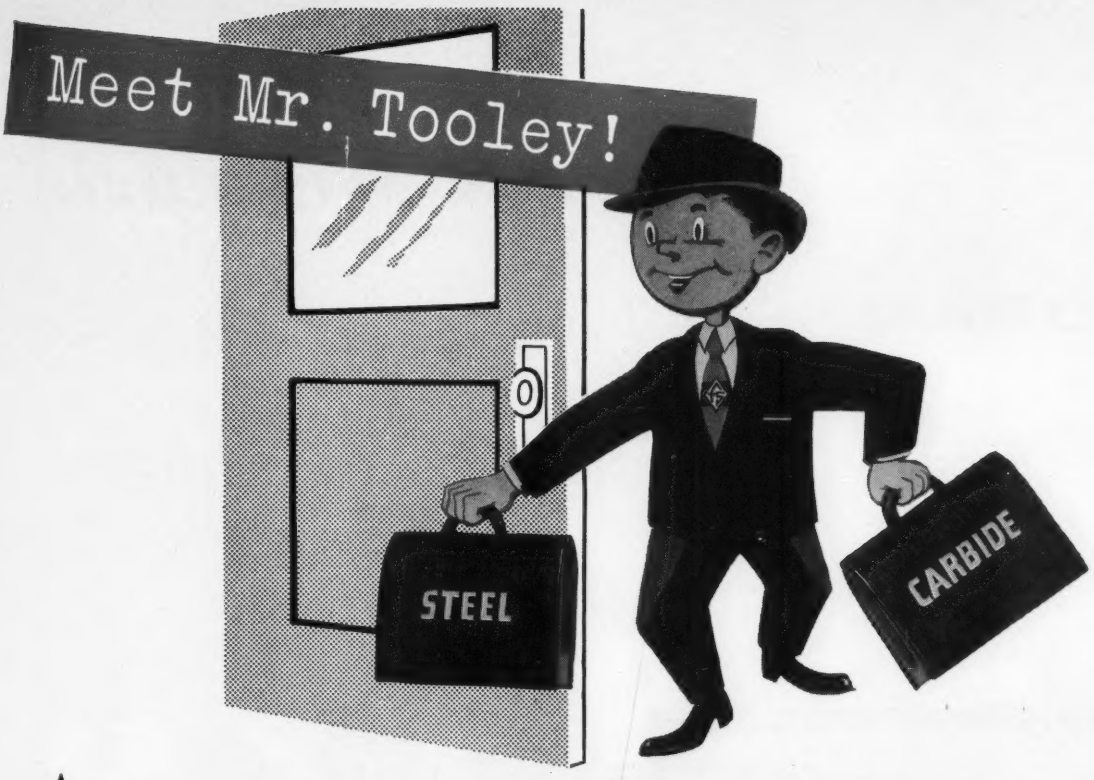
Our engineers came up with a special stainless steel wire that would take the severe forming stresses created in coiling long, thin springs. In addition, this wire could be made into springs with unusual resistance to permanent set. And, finally, this wire enabled the spring designer to create a spring with high initial tension . . . a sort of delayed action characteristic which prevented the spring from opening until the severe shock of deceleration was applied.

We solved this problem by staying with it long after most wire and steel makers would have given up. It is this stay-with-it approach that has enabled National-Standard to solve more of the fussy problems in steel and wire making than anyone else in the industry.

If you have a need for steel or wire with unusual or even "impossible" characteristics, check first with National-Standard. We may already be making such products. And, if we don't know how to make it now, we'll learn.

NS NATIONAL-STANDARD Company NILES, MICHIGAN

**NATIONAL-STANDARD COMPANY • NILES, MICHIGAN**
Tire Wire, Stainless, Fabricated Braids and Tape
**ATHENIA STEEL DIVISION • CLIFTON, N. J.**
Flat, High Carbon, Cold Rolled Spring Steel
**REYNOLDS WIRE DIVISION • DIXON, ILLINOIS**
Industrial Wire Cloth
**WAGNER LITHO MACHINERY DIVISION • JERSEY CITY, N. J.**
Special Machinery for Metal Decorating
**WORCESTER WIRE WORKS DIVISION • WORCESTER, MASS.**
Round and Shaped Steel Wire, Small Sizes




AMERICA is a land of symbols. The things we use and eat and wear, the services rendered to us, are often better known by their symbols than by their generic product names.

From Sunny Jim of yesteryear, who put packaged cereal on America's breakfast table, to Reddy Kilowatt who dramatizes electricity . . . "trade" symbols and characters have become loved and respected as representing reliability, versatility and often uniqueness.

*Our* Mr. Tooley is such a *symbol* to all industry where tooling for production is so important that it may even mean the difference between profit and loss.

For Mr. Tooley typifies the *unique* position that Firth Sterling occupies among producers of tools and tooling materials . . . that of making and selling *both steels and carbides* . . . the *right* steel or carbide or the exact combination needed to do each job best . . . from a single manufacturing source.

Thus Mr. Tooley has taken his place among American trade characters symbolizing a service of *greater* value built on Firth Sterling's ability to make *unbiased* recommendations and capacity to furnish *complete* shop tooling needs.

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—INC—

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OFFICES AND WAREHOUSES*: BIRMINGHAM CHICAGO* CLEVELAND DAYTON DETROIT* HARTFORD* HOUSTON LOS ANGELES* NEW YORK PHILADELPHIA PITTSBURGH WASHINGTON WESTFIELD, N.J.

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High Speed Steels
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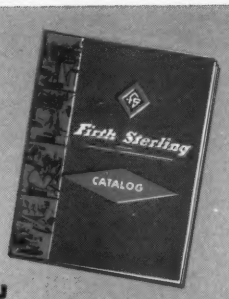


You'll find this catalog valuable in selecting proper machining materials: carbide standard tools, tips, inserts, blanks; steel toolholder bits, drill rod, ground flat stock. Get your copy from your Firth Sterling distributor or write direct.

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R-307

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Please send me the new 48-Page Firth Sterling Catalog.
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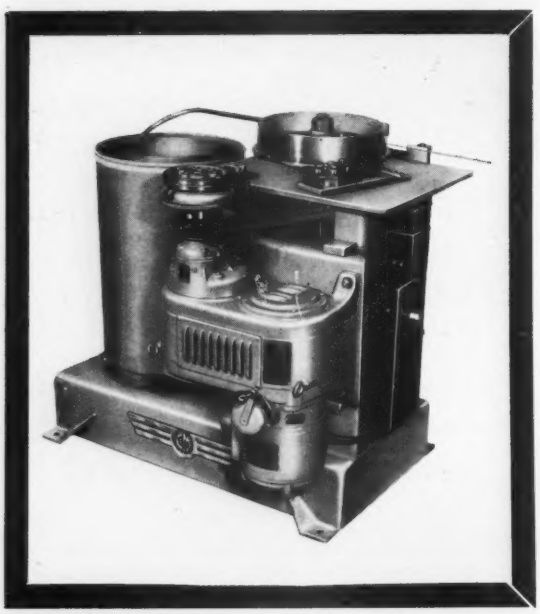
# *Coulter & McKenzie*

## DRAW · PAK *Equipment handles a new range of drum sizes!*



**MULTIPLE BLOCK INSTALLATIONS ARE AVAILABLE FOR PATENTING, TINNING TAKE-UP, ENAMELING, AND RESPOOLING OF MATERIALS FROM HIGH CARBON TO SOFT COPPER.**

**MODEL 327** — For use with drums having a capacity from 10 to 50 lbs. Designed for limited space and manual handling. Applicable to more precious wires or where short interrupted runs are required. Drum sizes from 8" dia. x 3½" — 9¼" ht.

**MODEL 227** — For use with drums having a capacity from 50 to 200 lbs. This DRAW-PAKing equipment is designed for one shift production and/or to suit existing plant space and handling. Drum sizes from 11" dia. x 11" — 20¾" ht.

**MODEL 127** — For use with drums having a capacity from 500 to 750 lbs. Provides the maximum unit package size which may be conveniently handled by mechanical means. Drum size 20" dia. x 30" ht. and 23" dia x 33" ht.

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Low cost wire packaging attachments are available. When writing, kindly furnish information on proposed application, and specifications of existing equipment and floor space.

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OPPOSITE RAILROAD STATION

TELEPHONE EDISON 5-1101
LIEBER'S CODE "MACKENZIE"

THE COULTER & McKENZIE MACHINE CO., INC.

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INCORPORATED 1901

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Hyprez used fo
flawless die finish o
modern Chicago plan
of Bronson & Bratton
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of tungsten-carbid
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wire industr

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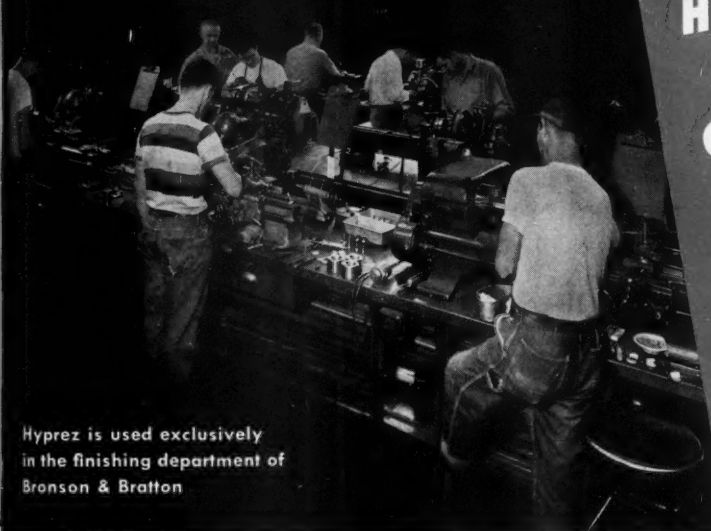
## High Precision DIAMOND COMPOUNDS

For economy of muscle, time and cost, Bronson & Bratton, Inc., Chicago, and scores of other die manufacturers and users, demand Hyprez, the original Diamond Compound.

Hyprez is engineered to highest standards of performance: diamond particles of exact grading and concentration; a vehicle assuring permanent suspension; integral color identification; maximum finishing action . . . A complete range of grades, from coarsest to finest.



Hyprez is used exclusively in the finishing department of Bronson & Bratton

***Ask for a free demonstration or technical bulletin No. W-355***

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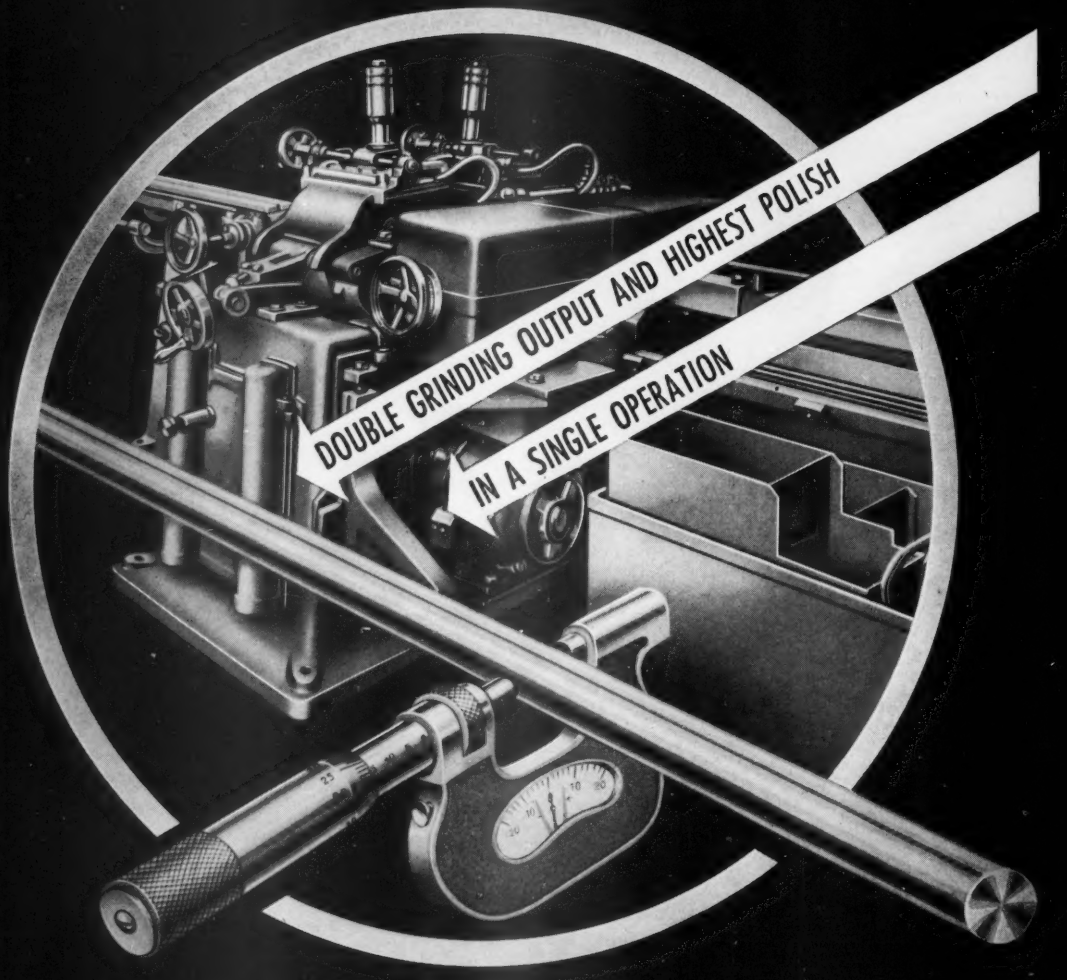
GRAPHIK JUPP KJCKARTZ

## CENTERLESS BAR GRINDING AND POLISHING MACHINE

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# WHERE HAVEG EQUIPMENT IS INSTALLED

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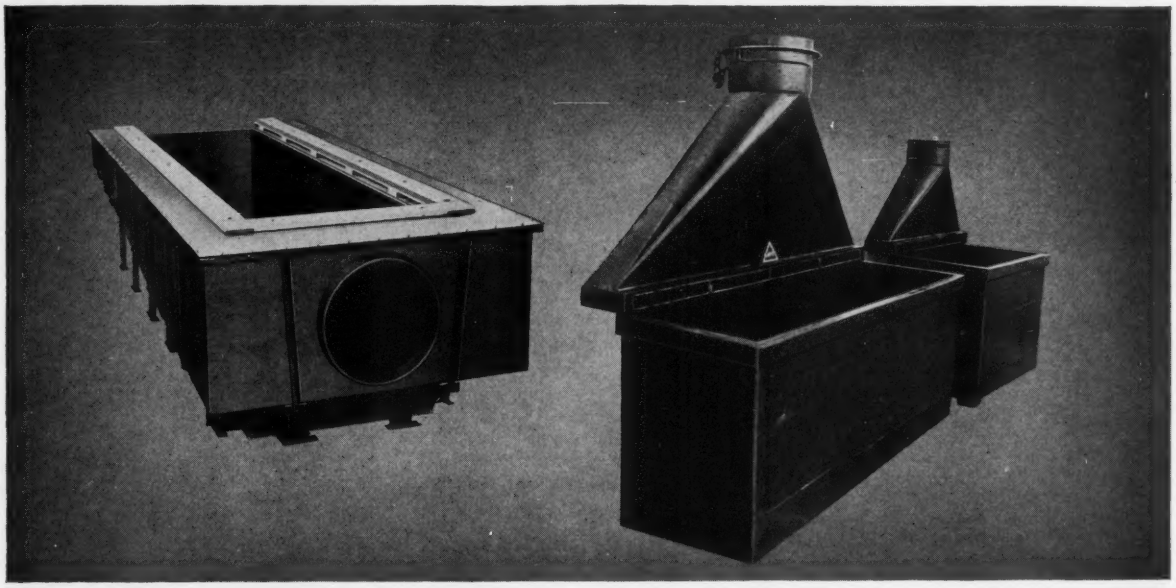
PICKLING, PLATING, DEGREASING TANKS • BASKETS • PIPING • VALVES
AGITATORS • PUMPS • FUME DUCT • BIFURCATORS • HOODS



## Metal Finishing Corrosion has been Controlled!

All Haveg equipment has extra long life, extreme resistance to corrosive chemicals, and can be used continuously in a high range of process temperatures with complete safety.

Because Haveg corrosion-resistant tanks prevent specking or flaking, the number of rejects is reduced, finished plating is uniform. Solutions do not build up on Haveg, reducing clean-up time.

Molded Haveg tanks are made in a single piece construction. Any size, style, baffle arrangement can be supplied to fit your process. They are made for long service life to improve production.

Remember, Haveg is not a coating or tank lining. It is a moldable rigid, plastic material made from acid-digested asbestos and specially selected synthetic resins. Throughout its entire mass, Haveg is resistant to most acids and salts, chlorine, practically all solutions used for finishing metals.

Haveg can help you make your finishing operations more profitable and less subject to the waste of corrosion. Call the sales engineer listed and write for 64-page Bulletin F-6 which shows tank sizes, shapes, chemical ratings . . . the complete Haveg story.

**NEW HAVEG POLYESTER GLASS TANKS**

Haveg polyester glass tanks for the metal-finishing industry are tough, can take hard knocks. They withstand the attack of acids normally used and are non-conductors of electricity. Where necessary, walls can be reinforced with corrugated construction or with steel ribs molded into the Haveg tank. Overflows for rinses also can be molded to fit your system. Write for more details.

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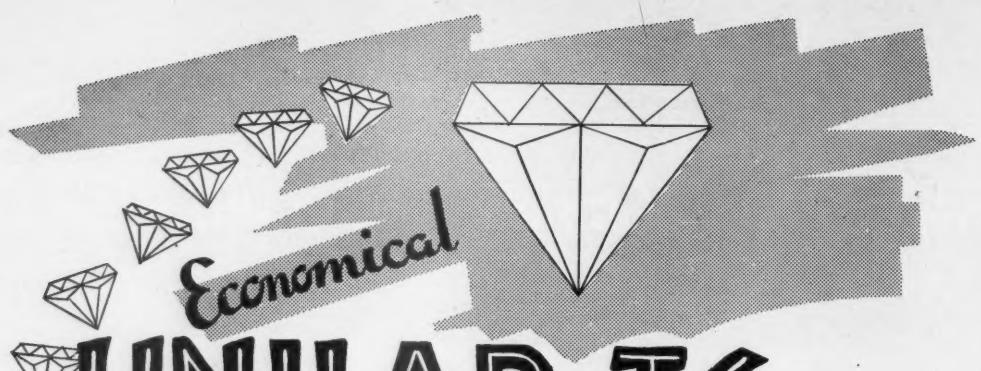

Economical

# UNILAP-TC

**A DIAMOND COMPOUND WITH MORE DIAMOND FOR LESS MONEY!**

**AND - WE TELL YOU HOW MUCH DIAMOND YOU ARE GETTING!**

Why should there be so much mystery about how much diamond there is in the diamond compound you buy? We WANT you to know exactly what you get when you use UNILAP-TC:

## UNILAP-TC: THE HIGHSPEED DIAMOND ABRASIVE

| GRADE NO. | COLOR | CARATS OF DIAMONDS PER GRAM | PRICE PER GRAM |
|---|---|---|---|
| 1 | Ivory | .50 | $2.00 |
| 3 | Yellow | .90 | 3.25 |
| 6 | Orange | 1.15 | 3.75 |
| 8 | Green | 1.20 | 4.00 |
| 15 | Blue | 1.25 | 4.05 |
| 30 | Red | 1.75 | 5.70 |
| 45 | Brown | 1.75 | 5.70 |
| 230-325 | Purple | 1.50 | 4.85 |
| 170-230 | Gray-Black | 1.50 | 4.85 |

Supplied in 5 gram cartridges, 5 gram jars, 7 gram tubes and 18 gram cartridges.

UNILAP-TC is sold on a money-back guarantee. If you are not satisfied that UNILAP-TC provides more efficiency and economy than any other compound you have used, just return the unused portion for full credit.

***For efficiency, for economy, try UNILAP-TC and compare!***

Buying diamond compounds merely on the basis of "they work" is costing you a lot of money. No pig-in-a-poke is the UNILAP-TC compound — you know what you are buying and you are buying

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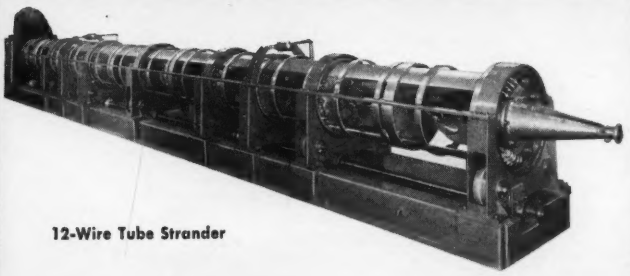
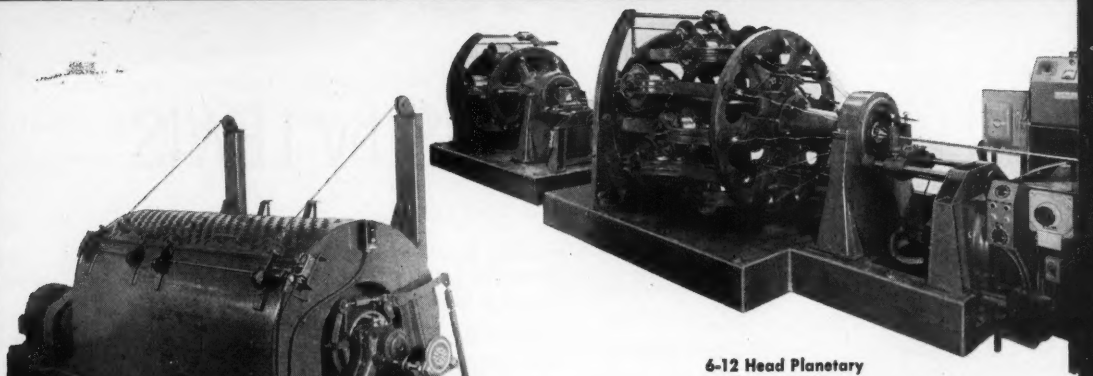
Wire Measuring Machine registers footage directly on counter.



12-Wire Tube Strander



6-12 Head Planetary Cabling Machine

Buncher . . . 1,000 R.P.M., 2,000 twists per min., 500 lb. spool

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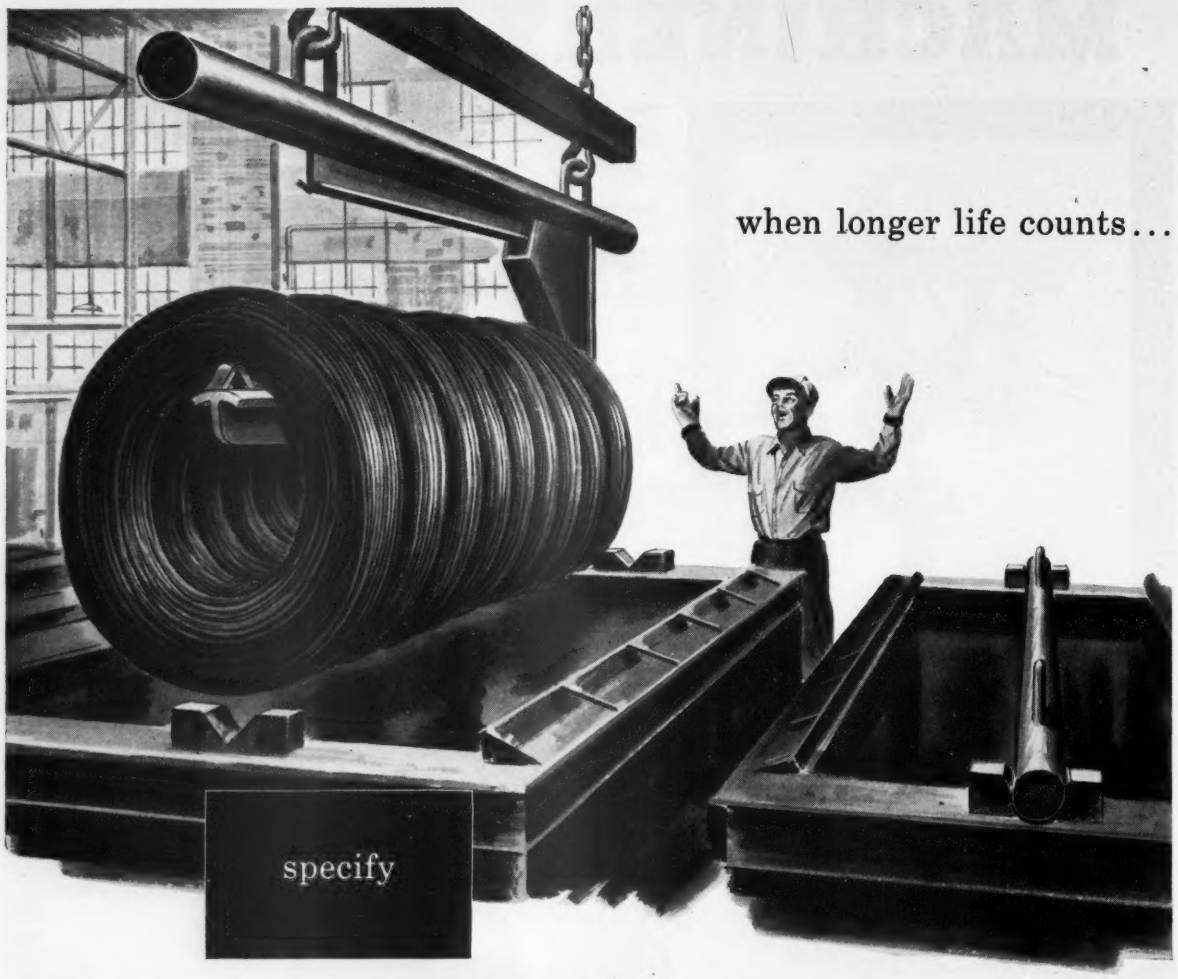
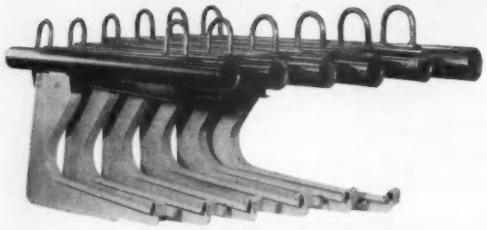



# MONEL PICKLING HOOKS by LEWIS



**STANDARD MONEL AND STEEL UNITS**
Are available in two types of construction and six sizes for a wide range of application.

**SPECIAL ALL-MONEL HOOKS**
For extremely corrosive conditions can be supplied on order in a range of sizes.

Designed for tough jobs . . . dependable performance . . . longer service life, LEWIS acid-resistant Monel hooks give you substantial savings in maintenance and replacement costs.

Standard units feature an extra ⅛-inch of metal on the part to be immersed in acid. In addition, the Monel hooks are bolted to low-cost steel spreader bars that can be replaced quickly and economically whenever necessary.

Another feature of LEWIS pickling hooks . . . important in cleaning operations . . . is a specially-designed drip trough on the load bar that picks up the condensate and carries it out beyond the bundles.

The winning combination of extra-heavy construction and low cost makes LEWIS Monel hooks your best buy for a wide range of pickling applications.

*Write today for complete details and prices.*

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LEWIS

**THE LEWIS WELDING AND ENGINEERING CORPORATION**
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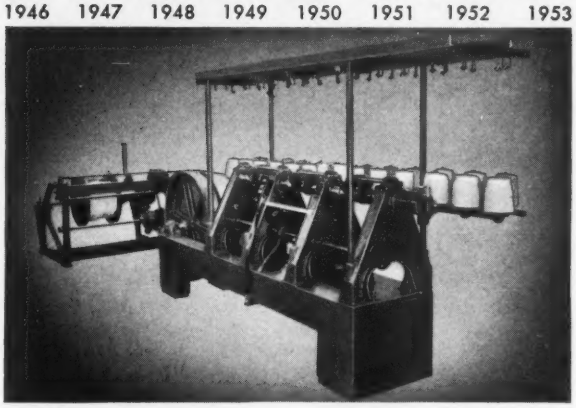
More and more, leading wire manufacturers the world over are proving the advantages of the *Fidelity Sinfra Knitter.**

With each new installation the *Sinfra* establishes —time after time—its ability to cover wire faster and more economically than any other method.

Today, the list of *Sinfra* users includes the world's foremost manufacturers of Wire and Cable.

Why not prove for yourself the outstanding advantages of this amazing machine? Write today for Catalog W or visit the new show rooms at our plant.



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*Designers and Builders of Intricate, Automatic Precision Machines*

SINCE 1911

# FIDELITY MACHINE COMPANY, INC.

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*Canadian Representative:*
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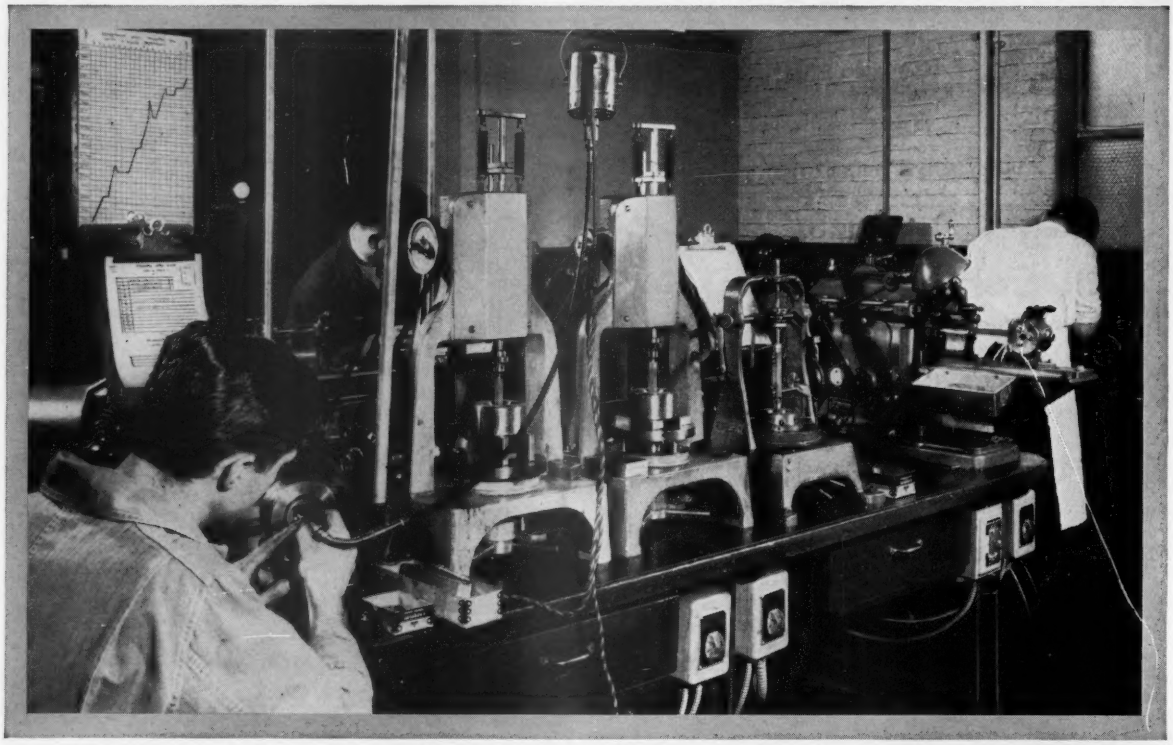
Increase production and
drawing efficiency with these . . .

# 5 Carboloy wire-die services



Typical Carboloy Die Service Center. Specialists check and service your dies on modern, precision equipment . . . fast. Four convenient locations: Chicago, Detroit, Los Angeles, Pittsburgh.

***These cost-cutting services are:***

1. **Fast die servicing and finishing** facilities in Chicago, Detroit, Los Angeles, and Pittsburgh.

2. **Large local stocks,** maintained in principal wire-drawing areas.

3. **Training school,** instructs your die-room personnel in design, application, and maintenance of carbide dies.

4. **Experienced Carboloy engineering service** in your own plant – to help solve your toughest design or production problems.

5. **Technical literature** – the most complete in the industry – to help you order, use, and service your carbide dies quickly.

Any of these Carboloy services will bring you appreciable savings in production time and operating costs.

Call in an expert Carboloy wire-die engineer, today. Or, write for Carboloy Die Catalog and Service Manual.

"Carboloy" is the trademark for products of the Carboloy Department of General Electric Company

**CARBOLOY**
DEPARTMENT OF GENERAL ELECTRIC COMPANY
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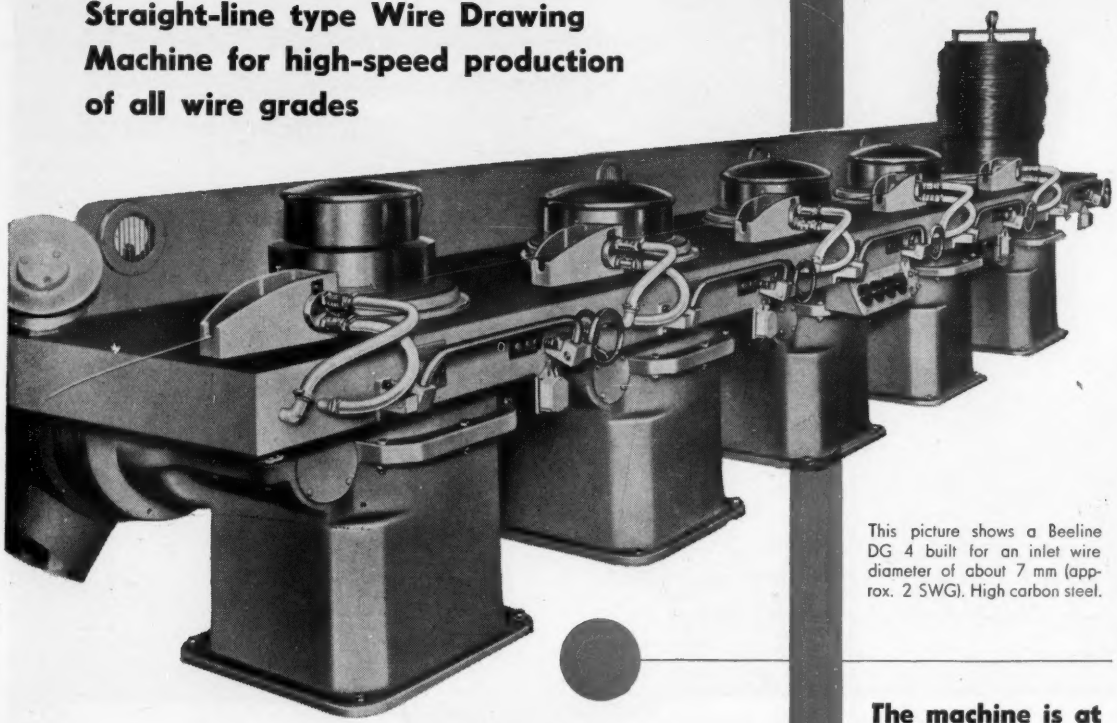
**Carboloy Created-Metals for Industrial Progress**

# THE BEELINE WIRE DRAWING MACHINE

**Straight-line type Wire Drawing Machine for high-speed production of all wire grades**



This picture shows a Beeline DG 4 built for an inlet wire diameter of about 7 mm (approx. 2 SWG). High carbon steel.

Prominent Beeline features:

- Complete absence of slipping between wire and block.
- Direct block-to-block wire running, with automatic speed control and no loops or other mechanical adjusting devices.
- Continuous speed adjustment from almost zero up to maximum.

Let us help you solve your problems. We shall be glad to answer your questions promptly. Don't forget to let us know what wire is to be drawn, the inlet and finished diameter, its intended use, the production required, and all other relevant information (tensile strength of the finished wire etc.). Then we can suggest a machine that is just right for you.

**The machine is at present manufactured in three different sizes:**

**BEELINE DG 5:**
for heavy wire, about 13 mm. (7/0 SWG)

**BEELINE DG 4:**
for wire rods, about 7 mm. (2 SWG)

**BEELINE DM 3:**
for wire with an inlet diameter of about 3 mm. (11 SWG)

MH

**MORGÅRDSHAMMAR**

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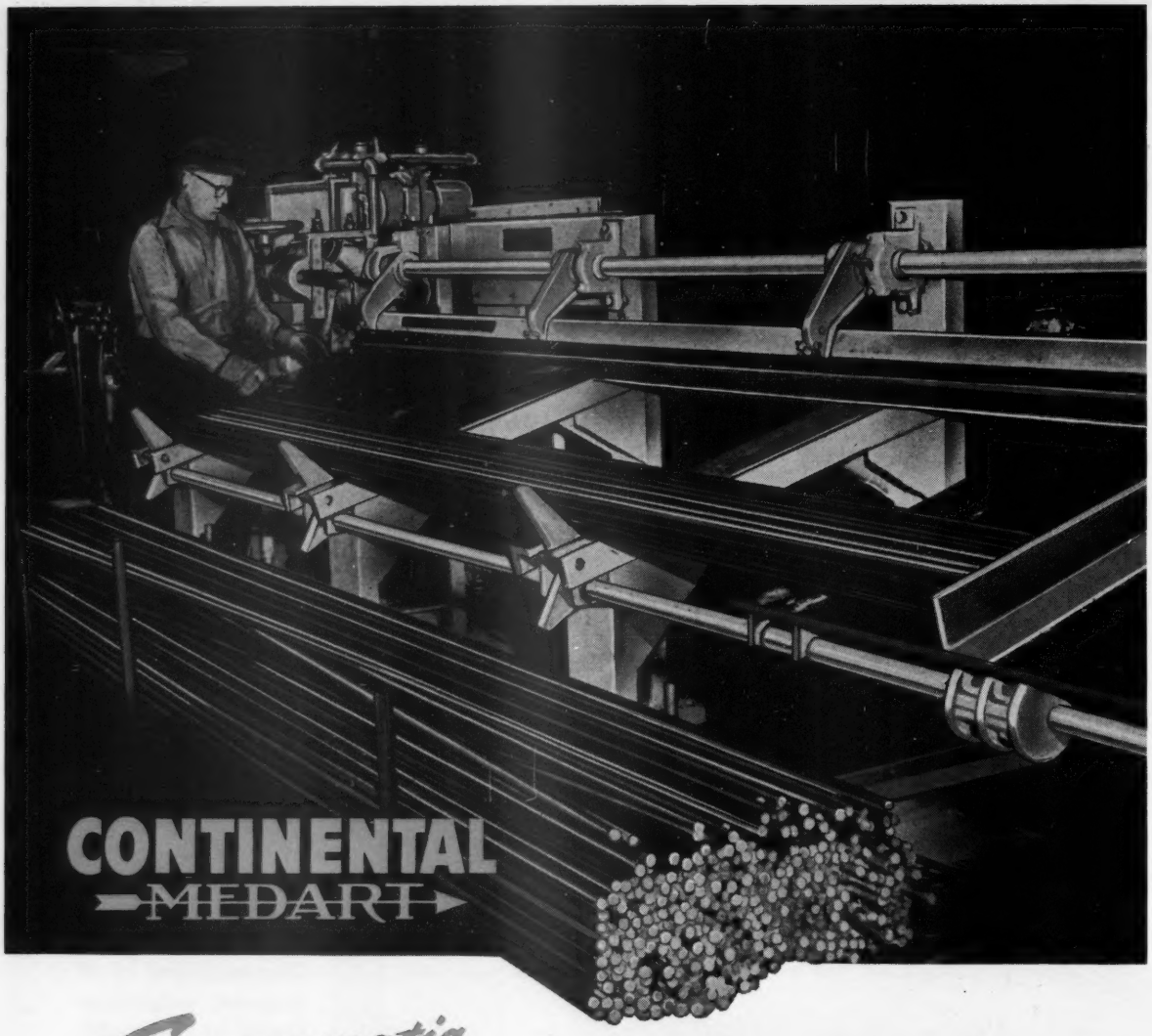
**Cables: Morgårdshammar, Ludvika. Tele: 0240–71100**




# *Supermatic*
## SHAPE STRAIGHTENER AND CUT-OFF

Now! High speed, precision straightening of any wire shape—flats, squares, rectangles, oval, hexagon or special—on the Continental-Medart Supermatic Two-Plane Straightener and Cut-Off. Operation is fully automatic, push button controlled and production is approximately twice that to be expected of conventional straighteners.

*Length gauge is electronically actuated and shearing is accomplished without pause.* Four machine ranges offer straightening over the complete range from 1/16" to 1" sections regardless of shape. If your operations involve precision shapes, investigate the Continental-Medart *Supermatic* Two-Plane Straightener and Cut-Off.

***Write*** **for descriptive bulletin 52AA or tell us your problem.**

**CONTINENTAL BUILDING, 220 Grant Street, Pittsburgh 19, Pa.**

**CONTINENTAL**
**Foundry & Machine Company**

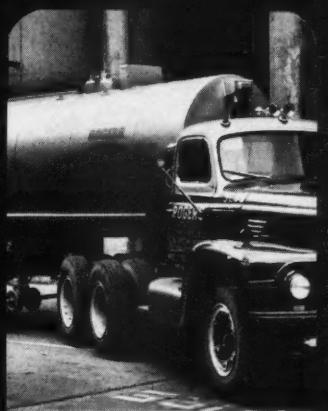
*Plants at*
**East Chicago, Ind. • Wheeling, W. Va. • Pittsburgh, Pa.**
***Copes-Vulcan Division*, Erie, Pa.**

# Monsanto PLASTICIZERS speed up processing, reduce production costs!

## MONSANTO PLASTICIZERS FOR VINYL-COATED WIRE

| TYPE WIRE | RECOMMENDED MONSANTO PLASTICIZER | ADVANTAGES |
|---|---|---|
| Type T and TW 60°C. UF-NMC Jackets | DIDP | Volatility ½ of DOP<br>Higher extrusion rate<br>Superior water resistance<br>Good electricals<br>Low pound volume cost |
| | DOP | High volume resistivity<br>Excellent uniformity of quality<br>Standard of the industry<br>Good electricals |
| SPT (lamp cords, etc.) | Santicizer S-160 | Low-cost primary plasticizer<br>Good electricals<br>Fast extrusion rate<br>Improves compatibility of secondary plasticizers |
| | HB-20 | Low-cost secondary plasticizer<br>Good color<br>Good electricals |
| 80°C. appliance wire<br>90°C. appliance wire | DIDP | High retention of elongation after extended heat aging<br>Good electricals |
| | TCP | Flame resistance<br>Low volatility<br>Grease resistance |

**Fast processing** and uniform quality are obtained with Monsanto plasticizers.



**Fast delivery** from bulk shipping stations in:

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Perth Amboy, N. J. St. Louis, Mo.
Greensboro, N. C. Los Angeles, Calif.

For technical bulletins on DOP, DIDP, S-160, HB-20, and information about tricresyl phosphate, write: Plasticizer Sales Dept., Organic Chemicals Division, MONSANTO CHEMICAL COMPANY, Box 478-N-1, St. Louis 1, Missouri

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CHEMICALS — PLASTICS

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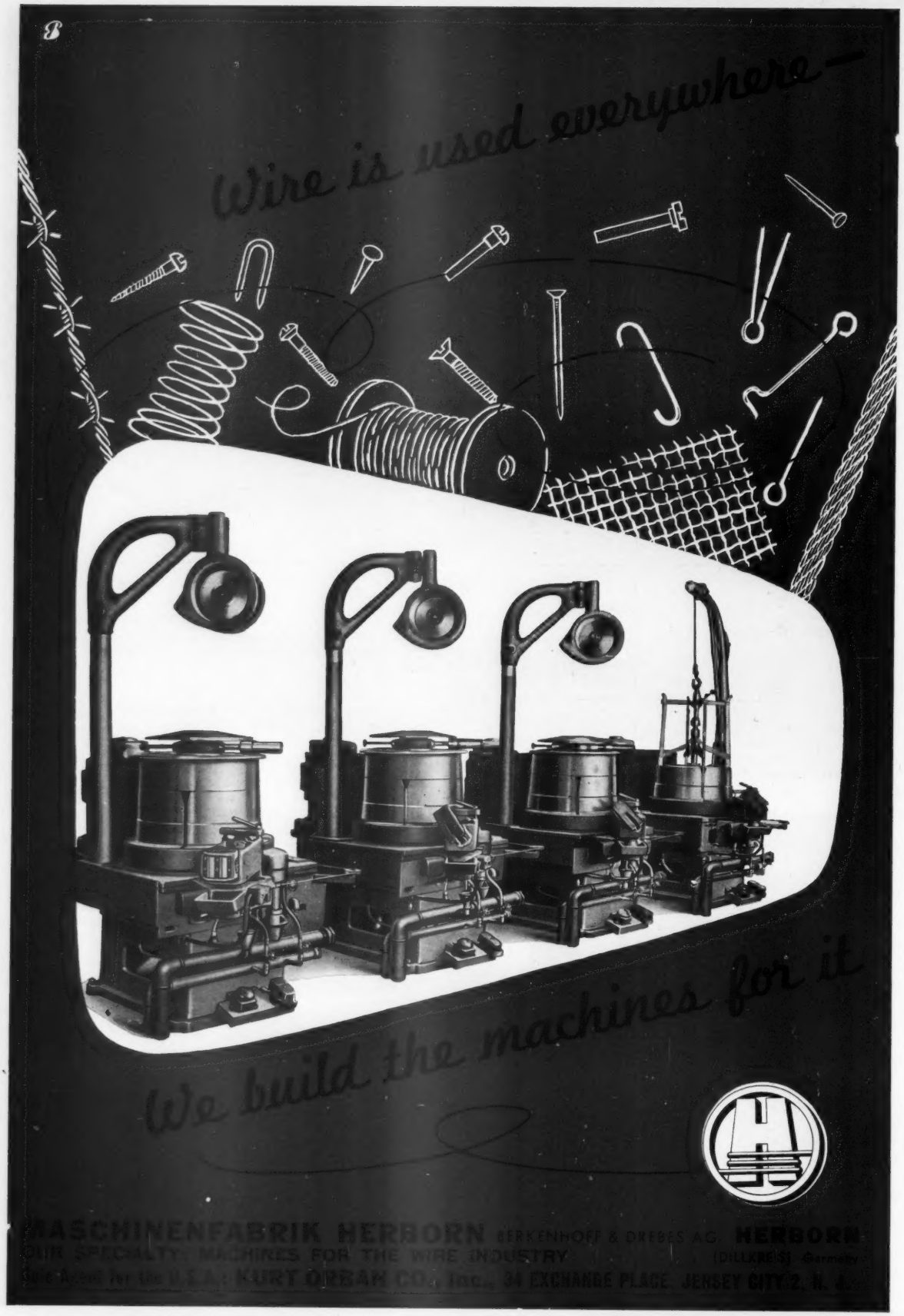
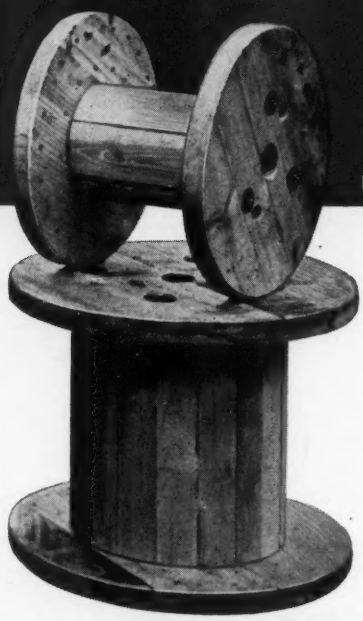

Wire is used everywhere—
We build the machines for it
MASCHINENFABRIK HERBORN BERKENHOFF & DREBES A.G. HERBORN
OUR SPECIALTY: MACHINES FOR THE WIRE INDUSTRY
(DILLKREIS) Germany
KURT ORBAN CO., Inc., 34 EXCHANGE PLACE, JERSEY CITY 2, N. J.

# WE have EXPANDED!
## in order to offer YOU...



## 1. BETTER SERVICE
## 2. FINER QUALITY
## on
# WOOD REELS
AND WOOD HEADS FOR STEEL DRUMS
## for
# CABLE • ROPE • WIRE

**THIS IS WHAT WE HAVE DONE IN THE LAST YEAR TO GIVE YOU BETTER REELS AT LOWER COST:**

- Considerably expanded the plant floor space.
- Equipped it completely with new machinery.
- Built new modern kilns for drying lumber.
- Added more trucks to the delivery fleet.
- Installed modern material handling equipment in buildings and yards.
- Paved over 6 acres of lumber yard space—which accommodates millions of board feet of lumber for reel manufacture only.

HIGH SPEED

**SHIPPING SERVICE in our... OWN TRUCKS**

within a radius of 200 miles from the plant. Fast freight will bring you Bridge reels in 5 days or less east of the Mississippi.

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HAZARDVILLE, CONNECTICUT

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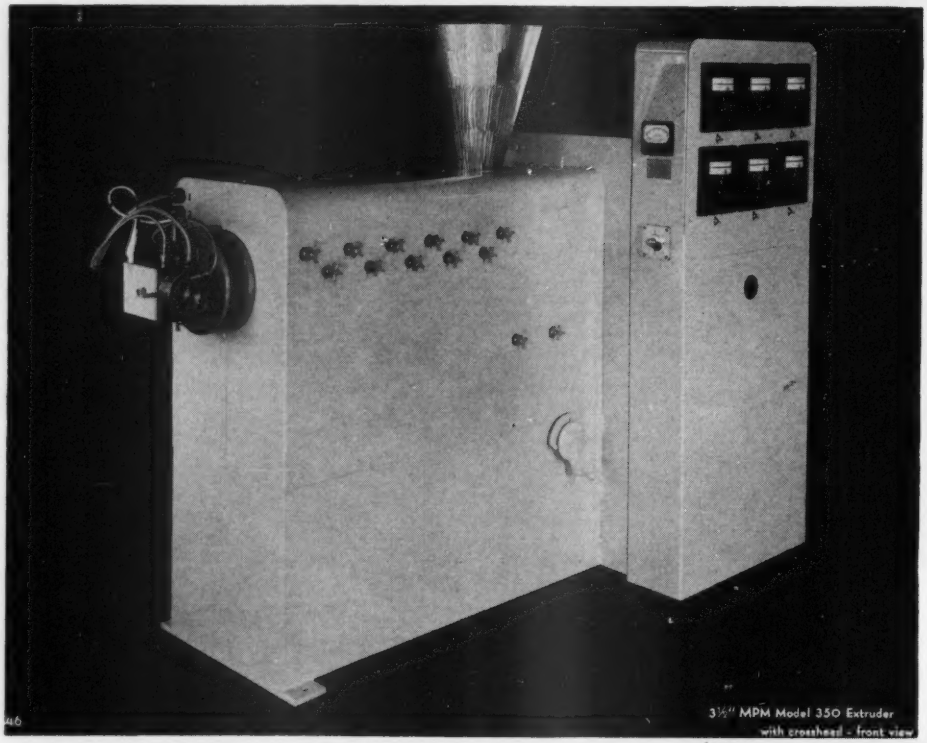
**"REAL GOOD..."**

Let us quote on your reel needs. Send your specifications. Better yet, visit our plant and see how and why our reels are made so well at so low a cost.

**WOOD REELS"**

# *"Modern"* INSULATING EQUIPMENT

## is designed for those electric wire manufacturers who demand the best in extruders.




Shown at left: 3½" MPM Model No. 350 Extruder with crosshead, front view.

MPM Extruders are used by nearly all material suppliers, by laboratories for quality testing, and for production. One large electric wire manufacturer now has 17 MPM Extruders-reorders for them indicate the satisfaction they give.

*MPM Extruders have the utmost flexibility and will handle a wide range of compounds and cross sections, as they are equipped with the best in temperature controls.*

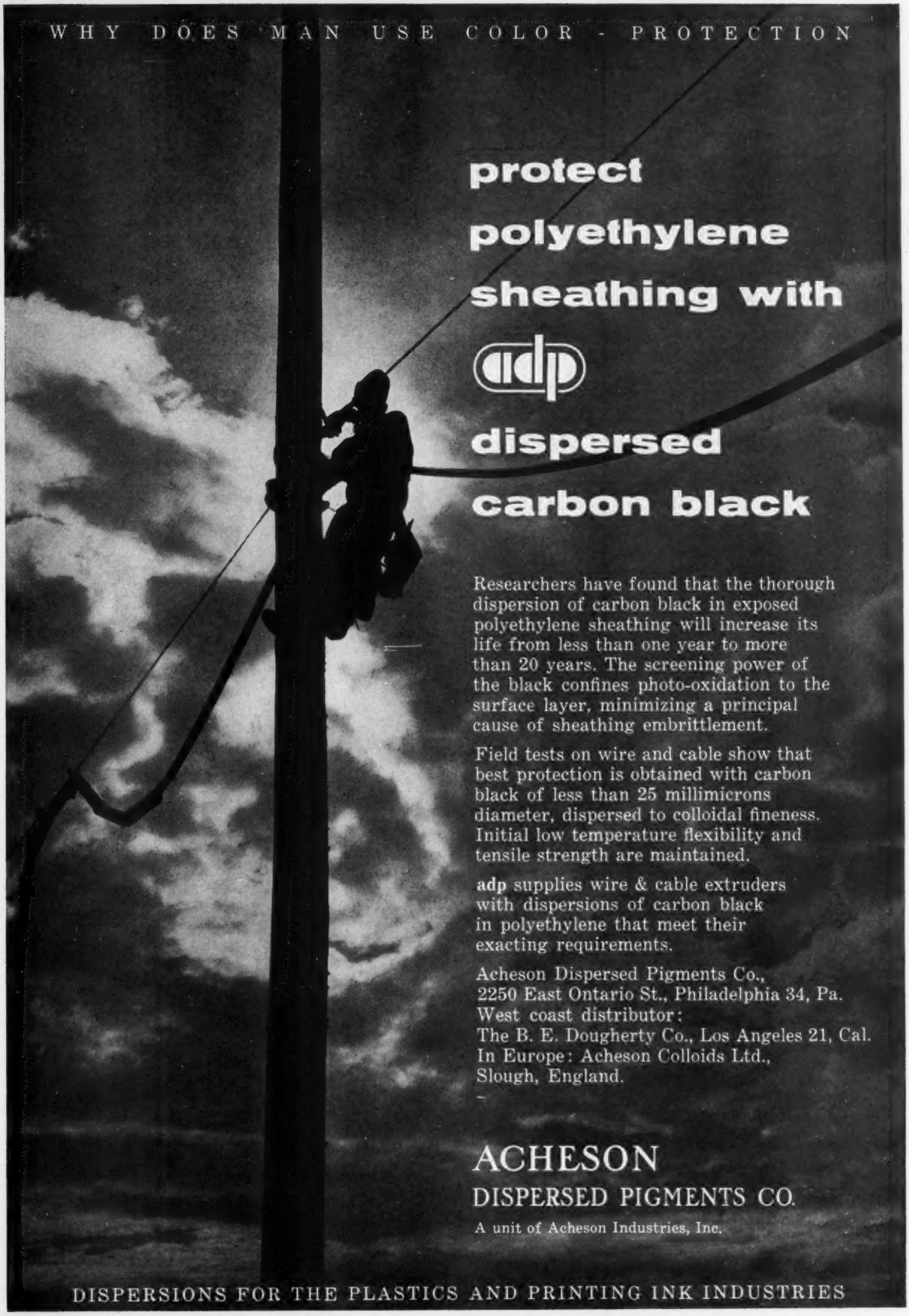
Literature upon request with questionnaire to determine the sizes, types and production requirements. MPM equipment is used in all principal foreign countries, indicating flexibility with many compounds.

Complete line of accessory equipment, such as dual take-ups, capstans, spark testers, measuring units and so forth.

**MODERN PLASTIC MACHINERY CORP.**

**15 UNION STREET • LODI, NEW JERSEY, U.S.A.**

**Telephone GRegory 3-6218**


WHY DOES MAN USE COLOR - PROTECTION
protect
polyethylene
sheathing with
adp
dispersed
carbon black
Researchers have found that the thorough dispersion of carbon black in exposed polyethylene sheathing will increase its life from less than one year to more than 20 years. The screening power of the black confines photo-oxidation to the surface layer, minimizing a principal cause of sheathing embrittlement.
Field tests on wire and cable show that best protection is obtained with carbon black of less than 25 millimicrons diameter, dispersed to colloidal fineness. Initial low temperature flexibility and tensile strength are maintained.
adp supplies wire & cable extruders with dispersions of carbon black in polyethylene that meet their exacting requirements.
Acheson Dispersed Pigments Co.,
2250 East Ontario St., Philadelphia 34, Pa.
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In Europe: Acheson Colloids Ltd.,
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ACHESON
DISPERSED PIGMENTS CO.
A unit of Acheson Industries, Inc.
DISPERSIONS FOR THE PLASTICS AND PRINTING INK INDUSTRIES

# *HUBBARD Can Supply You With All Types of*

# NON-RETURNABLE SPOOLS and REELS

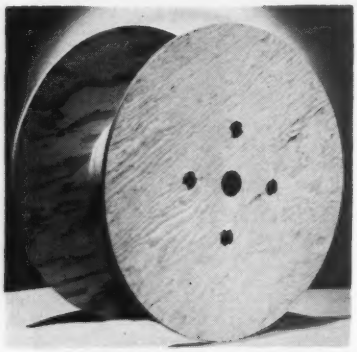
*for*

**WIRE • ROPE • TAPE • BRAID • PLASTIC EXTRUSIONS**

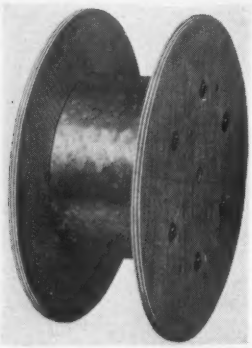
**Pictured and described below are a few of these types:**

Cutting cores to length and assembling reels.

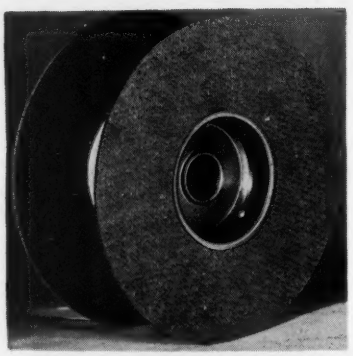
Hubbard non-returnable reels loaded and ready for shipment.



Reel with plywood flange with cardboard hub assembled with tubular rivets for non-returnable and export shipments.



Reel with plywood flange and galvanized steel hub assembled with tubular rivets and special washers for heavier loads.



Reel with masonite flange and cardboard hub assembled with steel end washers for domestic or export shipment of wire, tape, braid or other materials.

**OTHER TYPES OF ALL-WOOD OR PLYWOOD SPOOLS AND REELS IN ANY COMBINATION OF CONSTRUCTIONS THAT WILL SUIT THE CONDITIONS OF USE AND SHIPMENT.**

***Special reels will be made to your specifications.***

## HUBBARD SPOOL COMPANY

GARRETT (Tel.: Garrett 840) INDIANA

"THE BIGGEST NAME IN SPOOLS AND REELS"

S.S. United States . . . most modern, fastest liner afloat.

# Nothing finer!

A statement from
a conservative organization:

*"Our records show that when a manufacturer once discovers the uniform quality of Roebling flat spring steel, he becomes a steady Roebling customer."*

You, too, *pay* for the best spring steel . . . make sure you *get* it. Specify Roebling. John A. Roebling's Sons Corporation, Trenton 2, N. J.

**ROEBLING** CF&I

*A subsidiary of The Colorado Fuel and Iron Corporation*

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# For Accurate WIRE MEASURING and AUTOMATIC SIGNALING

This new machine by Davis-Standard accurately measures wire and cable footage at high speeds, and reverses itself automatically at preset limits. At the end of each cycle, it sends out an electrical impulse which can operate a signal, stop a take-up and pay-off combination, or trigger the automatic reel cutover on a continuous take-up.

No reset is needed. Machine counts between zero and preset limit, emitting a signal and reversing itself at each end of the range. No wire footage is lost during reset.

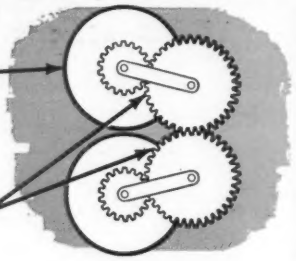
Also available with totalizing and hand lever reset counters, both plain and predetermining. Wheels with specially hardened and surfaced rims can be furnished for bare wire measurement. Available with or without floor stand. Deflecting sheave can also be provided for guiding wire to next unit in wire line.

Maximum wire speed — 2500 ft./min.
Maximum cycle limit — 80,000 feet
Maximum cable diameter — 2 inches

## ACCURACY WITHIN 0.1 PERCENT BECAUSE . . .

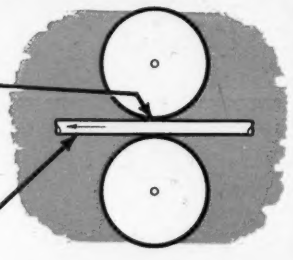
Measuring Wheels
are of light aluminum for low rotary inertia. Rims are coated with hardened steel for wear resistance.

Large 18" Circumference
measuring wheels are both geared to counter. No idler to impair accuracy of count.



Spring Loading
of wheels provides light, adjustable pressure for maximum accuracy with varying degrees of insulation hardness.

Most Accurate
count is obtained by wire passing straight through machine, touching wheels only tangentially.



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## SALES CORPORATION

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SOLE SELLING AGENTS FOR . . . THE STANDARD MACHINERY COMPANY, World's Largest Manufacturers of Custom-Built Extruding Machines
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QUALITY YOUNGSTOWN SERVICE

BRIGHT BASIC WIRE

●Quick as the hand puts the shank of a bolt between die plates, a perfect thread is rolled. Millions of perfect threads are possible because Youngstown Bright Basic Wire from which these bolts are formed is manufactured from thoroughly conditioned steel and drawn to exact tolerances. For further information, write or phone our nearest District Sales Office.

**THE YOUNGSTOWN SHEET AND TUBE COMPANY** *Manufacturers of Carbon, Alloy and Yoloy Steel*

General Offices: Youngstown, Ohio - District Sales Offices in Principal Cities

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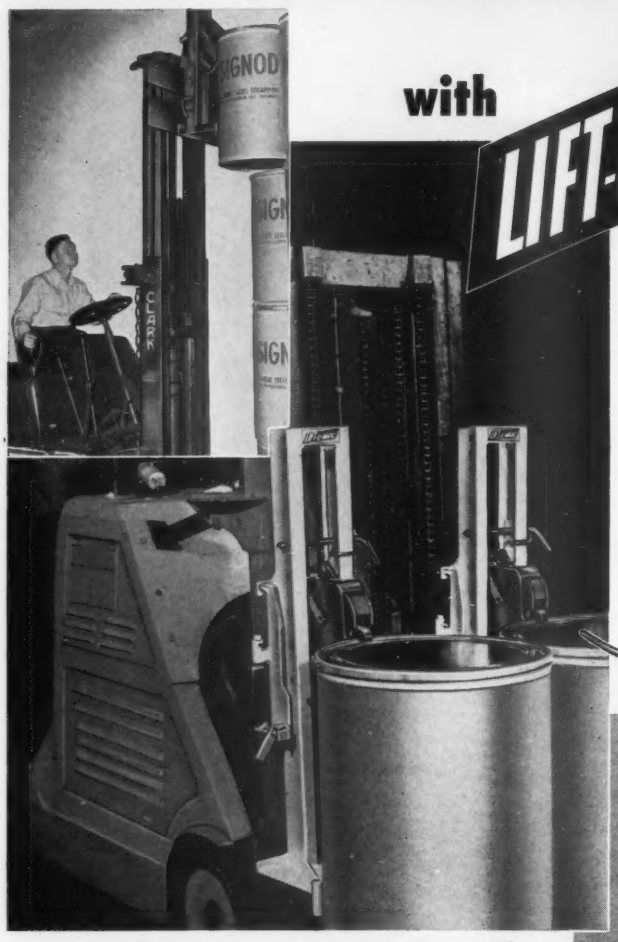
# MOVE YOUR Leverpak / Payoffpak } FIBRE DRUMS (OR STEEL)

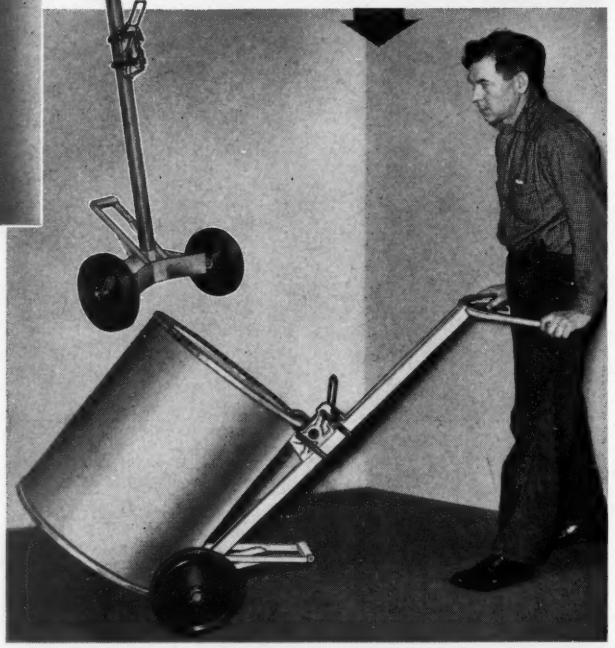
with MATERIAL HANDLING EQUIPMENT **LIFT-O-MATIC**

- SAFELY
- AUTOMATICALLY
- EASILY
- ECONOMICALLY



## MANUAL DRUM TRUCK

Automatic engagement and release. No prongs or studs to damage drum. Quickly adjustable for drums of any height. Exact placement without any manual handling. Light, (45 lbs.) all-steel welded construction. Steel disc wheels, with full roller bearings, equipped with solid demountable or molded-on rubber tires.



## POWER TRUCK ATTACHMENT

One operator can attach or remove in only 2 minutes. Fits any truck, or can be interchangably used on different makes. Engages drum from top only, without damage to bead or rim. Handles all drums, singly or in multiples, regardless of size or kind, open or closed. Automatic, mechanical, maintenance-free operation, without additional operator control. No pallets needed for transporting or tiering.

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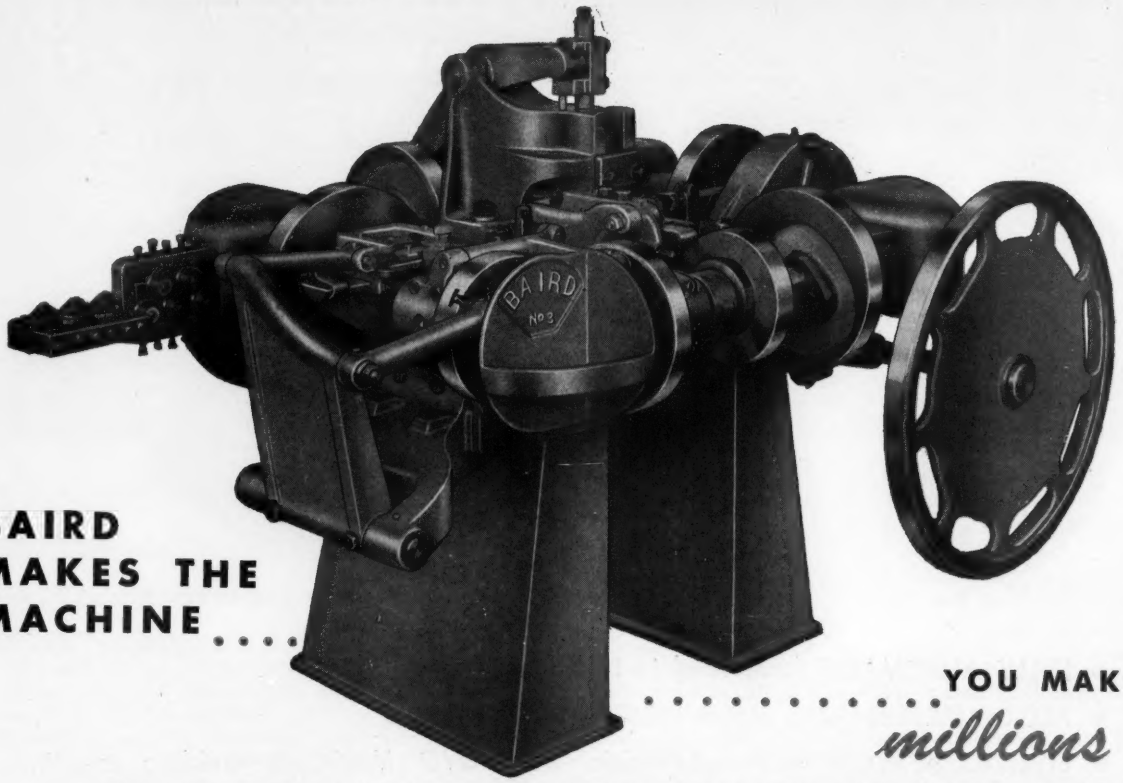
OR WRITE US

ASK BAIRD ABOUT IT!

# HIGH PRODUCTION TOOLING




BAIRD MAKES THE MACHINE . . . . . YOU MAKE *millions*

## . . . OF ACCURATELY FORMED WIRE AND RIBBON METAL PARTS

The Baird automatic Four-Slide Machine produces an extremely wide variety of articles made of any commercial wire . . . round, half-round, square, or flat . . . at highest speeds. It takes coiled wire from a reel, straightens, feeds, and cuts off the required length . . . then forms and ejects the part produced. Eight sizes handle shorter wire lengths; three sizes take longer lengths to 32½".

By means of special attachments, the versatility of the machine is further extended to include the making of round wire and ribbon metal rings, secondary cut-offs, lettering, and other operations.

The detailed and complete story, with specifications, is told in our new Four-Slide Bulletin. If you require hundreds of thousands or millions of wire units to ½" dia., or flat ribbon metal products to 1½" wide . . . this is your profit-making machine. Send for bulletin. Write Dept. W P.

3BA53

*the* BAIRD MACHINE COMPANY
STRATFORD • CONNECTICUT

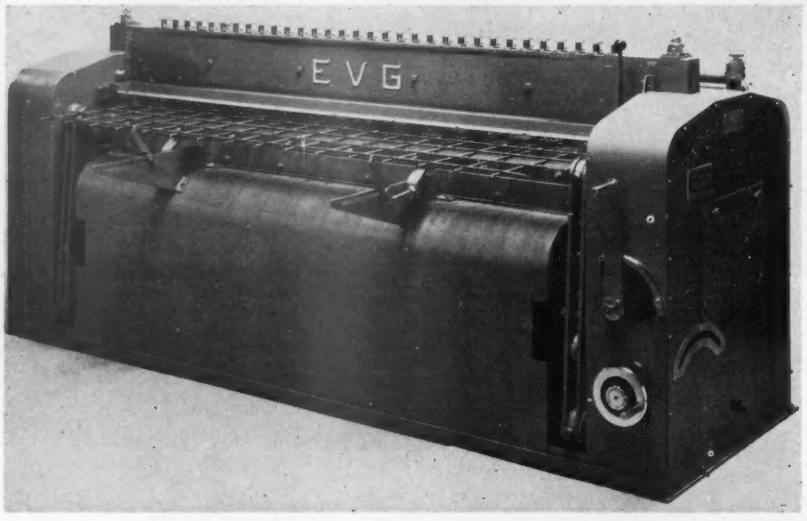
AUTOMATIC MACHINE TOOLS • AUTOMATIC WIRE & RIBBON METAL FORMING MACHINES • AUTOMATIC PRESSES • TUMBLING BARRELS

# RESISTANCE WELDING MACHINES

*for*

## WELDED WIRE FABRICS

Well-known for years throughout Europe, the complete **EVG** line of Wire Fabric Welding Machines is now being introduced for the first time to the American market.




- FULLY AUTOMATIC from feed to take-up.
- ALL DIAMETERS—ALL MESH SIZES—ALL SPACINGS
- ELECTRONICALLY TIMED and Precision Built, EVG Multi-Spot welding machines offer a new achievement in SPEED, ACCURACY and UNIFORMITY of product.

Three standard types*, known as the "UNIVERSAL," the "PRECISION" and the "HIGHSPEED" produce fabric and mesh in widths from 72" to 156". Wire gauges (AS&W) accommodated are 6/0-12, 5-14 and 16-22. Mesh spacings from 1/2" upward in 1/2" steps. Productions speeds up to 90—100 cross wires per minute.

***Special machines can be manufactured to your own specifications to meet your particular requirements.**

ENGINEERED AND BUILT BY

**ENTWICKLUNGS VERWERTUNGS GESELLSCHAFT**
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***Please direct inquiries to***

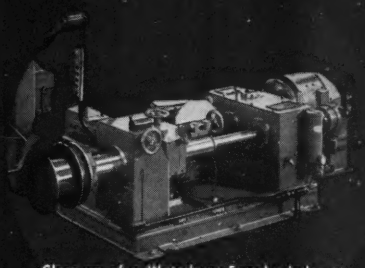
**RICHARD E. KLEINHANS**

**Authorized Representative in the United States.**

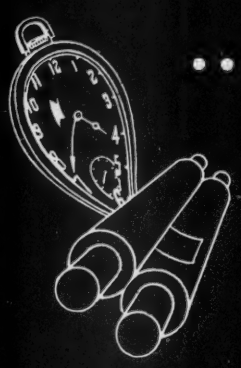
**122 EAST 42nd STREET • Tel.: OXford 7-0770 • NEW YORK 17, N. Y.**

# THIS WF WIRE FLATTENING TEAM

## . . . SQUEEZES "DOWN-TIME", TOO



Close-up of a Waterbury Farrel winder at the delivery end of a WF Tandem Mill. Winder is provided with pneumatic clamping of reels. It has three adjustments for width of wire and width and positioning of drum or spool.



This complete Waterbury Farrel mill package includes 10" and 8½" Tandem Wire Flattening Mills, power driven double head Pay-off, Edger, Winder, footage counter, continuous thickness and width gauges and automatic electrical synchronizing control. Other WF tandems with up to five mills available.

## Modern Waterbury Farrel Mill Design Insures High Production Plus Precision . . . Minimizes "Down-Time"

Here are some reasons why Waterbury Farrel Wire Flattening equipment can give you *more continuous,* high speed, precision production.

- Loading payoff and motor driven screwdowns for mills and edgers facilitate threading of wire with minimum effort and time.
- To protect precision operation, soluble oil is circulated internally and externally on the rolls and into coolant enclosures where wire is submerged. A refrigeration system maintains the coolant oil temperature at approximately 70° while a flotation unit keeps it clean and fresh. In addition, high speed mills also have a self-contained, automatically-filtered circulating mineral oil lubrication system for roll necks and drives.
- Transparent lucite covers at vital lubrication points such as gear cases and universal joints make it easy to check lubrication at a glance.
- Anti-friction bearings are used for all rotating members including the winder shaft. High precision anti-friction bearings are used on roll necks and edger arbors. This, combined with precision fitting of component parts enables WF mills to maintain tolerances well inside commercial allowance.
- Tungsten carbide ring rolls permit rolling the toughest alloys and increase roll life.
- Electric control keeps wire tension constant. Dancer rolls are used for fine wire.

Waterbury Farrel designs and builds a wide range of wire flattening mill equipment to suit specific requirements. Various sizes and combinations of single and multiple mill stands with auxiliary equipment are available for flattening ferrous and non-ferrous wire from the smallest diameters to 1" diameter and more. Speeds range up to and above 2500 FPM.

*Write for further information.*

**WATERBURY FARREL FOUNDRY & MACHINE CO.**
**WATERBURY 20, CONN.**
**Sales Offices: Chicago, Cleveland, Millburn, N. J.**

WATERBURY FARREL FOUNDED 1851

**A FEW OF THE MANY TYPES OF METAL WORKING MACHINERY MADE BY WATERBURY FARREL**

*MILL MACHINERY*—Rolling Mills: Strip, Rod, Wire Flattening, (For Ferrous and Non Ferrous Metals) • Also Slitters • Straighteners • Cut-off Saws • Coilers • Winders, etc. *WIRE MILL EQUIPMENT*—Continuous Wire Drawing Machines (Upright Cone and Tandem) • Wire Flattening Mills • Chain Draw Benches • Pointers Swagers • Bull Blocks • String-up Machines • Spoolers, etc. *COLD PROCESS BOLT & NUT MACHINERY*—Headers (all types) • Rivet Machinery • Trimmers • Thread Rolling Machines • Slotters • Nut Formers and Tappers, etc. *POWER PRESSES*—Crank, Cam and Toggle; also Rack and Pinion Presses • Eyelet Machines Multiple Plunger Presses • Horizontal and Hydraulic Presses, etc.

WF 9

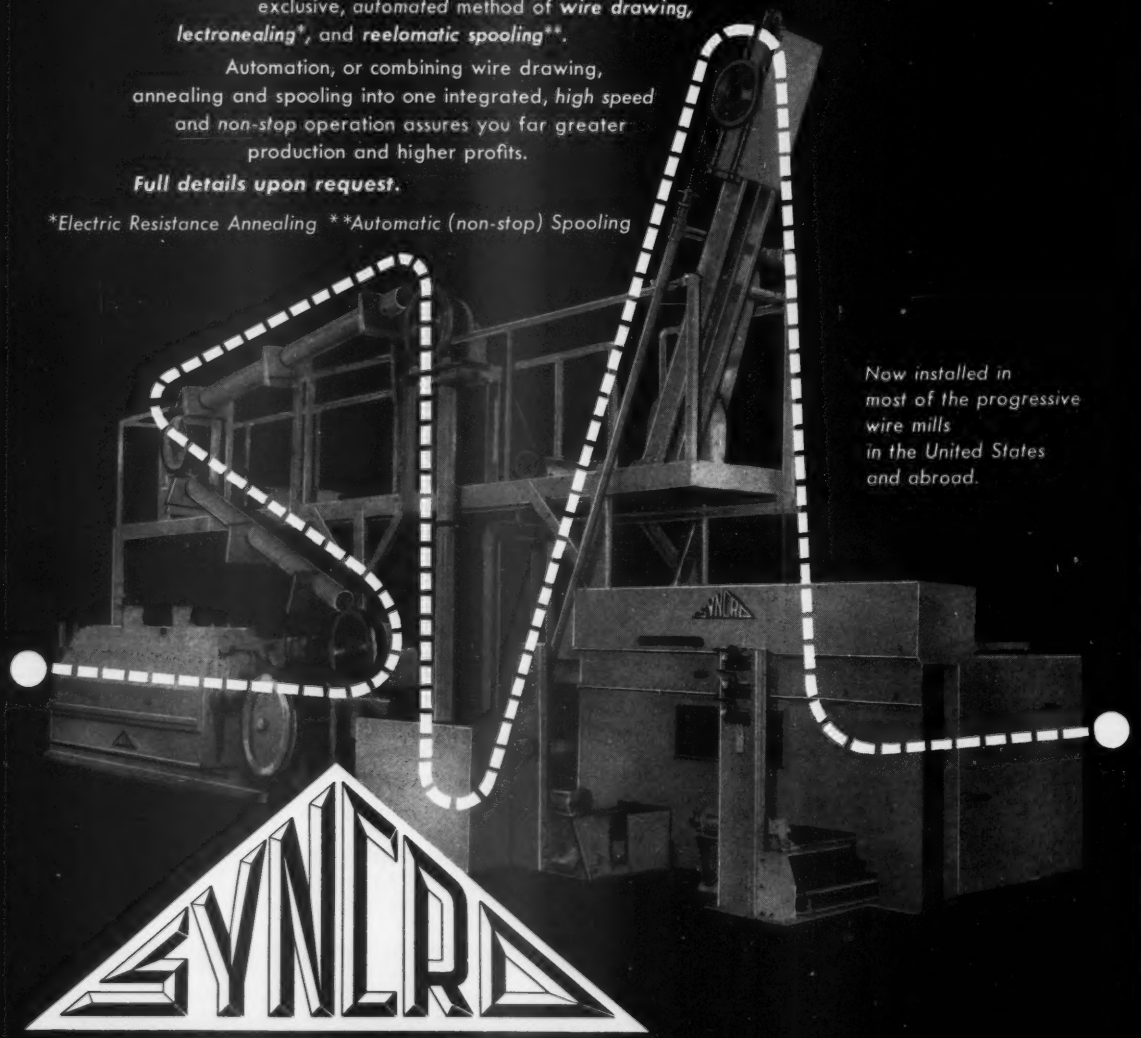
# SUREST LINE FOR COPPER WIRE PROFITS!

Designed specifically for copper wire and cable mills, only SYNCRO offers you this exclusive, *automated* method of ***wire drawing, lectronealing**, and **reelomatic spooling*****.

Automation, or combining wire drawing, annealing and spooling into one integrated, *high speed* and *non-stop* operation assures you far greater production and higher profits.

***Full details upon request.***

**Electric Resistance Annealing* ***Automatic (non-stop) Spooling*



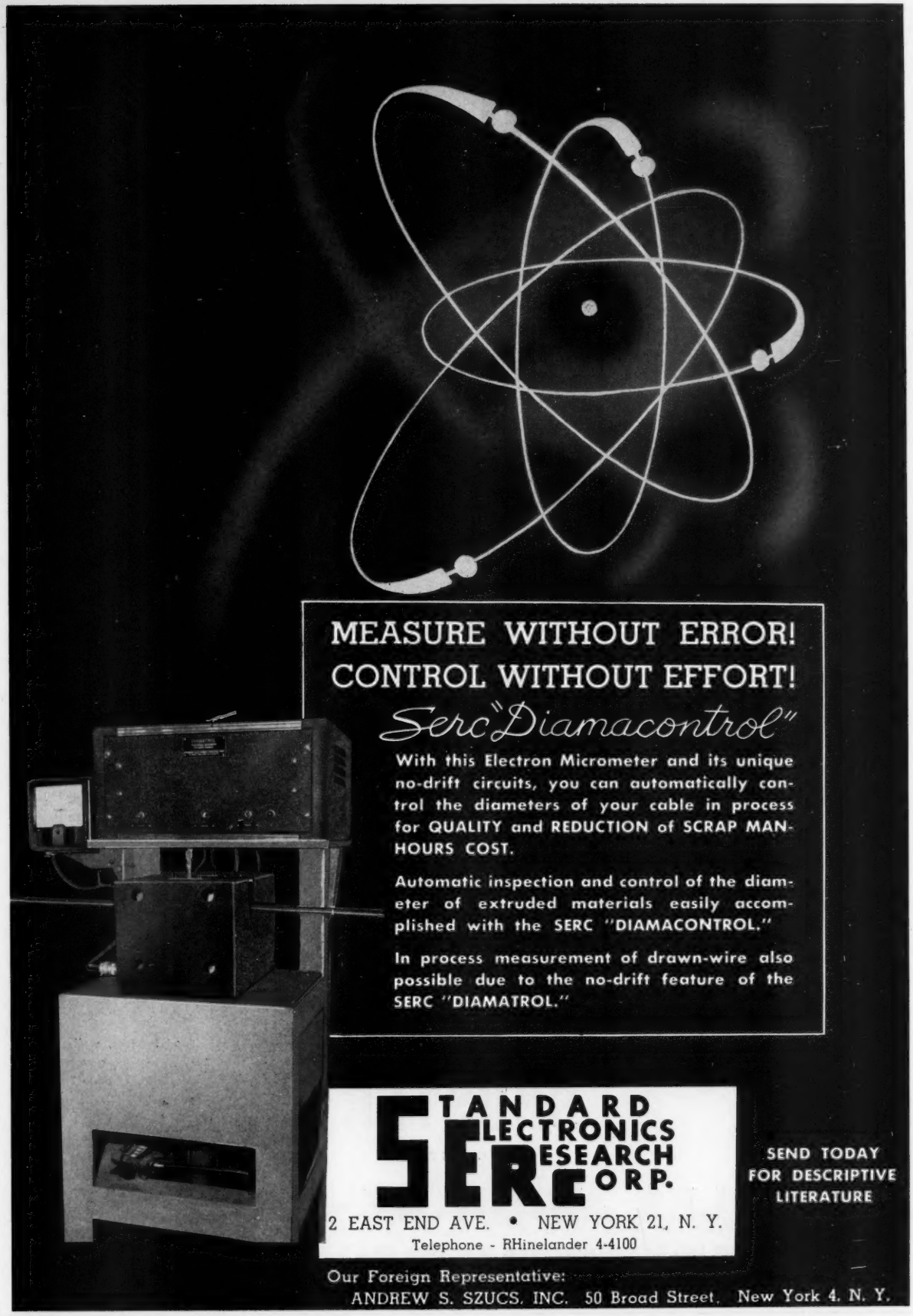
*Now installed in most of the progressive wire mills in the United States and abroad.*

SYNCRO

*Better Machinery for the Wire Industry*

**SYNCRO MACHINE COMPANY**

**Perth Amboy, New Jersey, U.S.A.** affiliated company: WINGET-SYNCRO Ltd., Rochester, Kent, England


MEASURE WITHOUT ERROR!
CONTROL WITHOUT EFFORT!
Serc "Diamacontrol"
With this Electron Micrometer and its unique no-drift circuits, you can automatically control the diameters of your cable in process for QUALITY and REDUCTION of SCRAP MAN-HOURS COST.
Automatic inspection and control of the diameter of extruded materials easily accomplished with the SERC "DIAMACONTROL."
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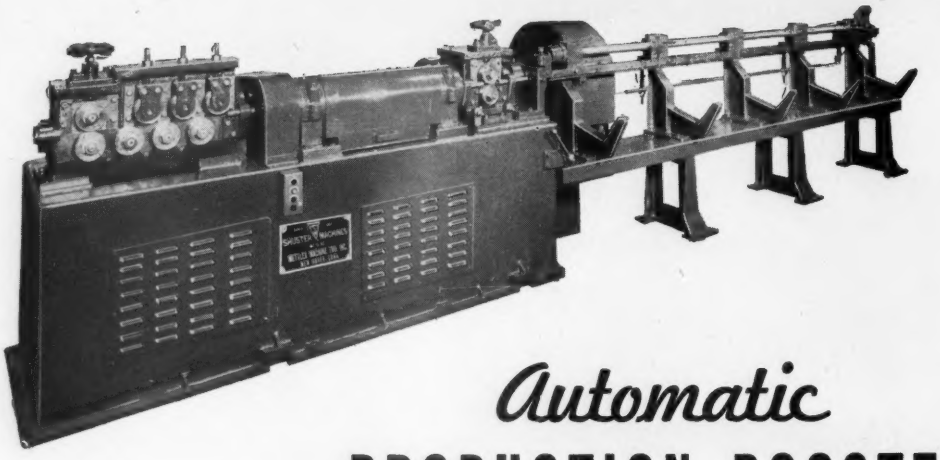
# SHUSTER MODEL 3 A



## *Automatic* PRODUCTION BOOSTER

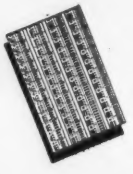
Here is SHUSTER'S "3 A" Automatic Production Booster! It straightens and cuts heavy stock (¼" to ½" diameter basic wire) with extreme accuracy. It feeds fast, cuts fast, and delivers *straight* wire, with undistorted, square-cut ends. It will boost production in your plant for years to come!

### OUTSTANDING FEATURES:

- Instantaneous clutch and cut-off cam
- Lightning cutoff knife for clean, true, square-cut ends
- Ball and roller bearings throughout
- V-Belt motor drive for quiet, efficient operation
- Preliminary Straightener: The feed rolls and the lower breaking rolls are gear driven, and mounted on Timken Roller Bearings. The upper breaking rolls are not gear driven, but are mounted on anti-friction bearings. This device removes the natural curve of the coil and rough straightens the wire before it enters the rotary flier to be made perfectly straight.
- 5-Die Straightening Flier. Highspeed drive creates high production standards.

SHUSTERS are available for .025" to 11/16" diameter wire: shapes, flat stock, tubing. Write us your requirements.

Representatives in all principal cities.



Send for free, wall-size, split gauge wire chart, from 41 gauge to 7/0.

**SHUSTER**

SINCE 1866

## METTLER MACHINE TOOL, INC.

155 West Adeline St., New Haven, Conn. New York Office: 11 Broadway, WH 4-5480

# There's room for greater profits

*...with the NEW Torrington W3001*
**TORSION SPRING WINDER**

*Room* — room in which to work — is the outstanding feature of Torrington's new torsion spring winder. This modern, high production machine actually provides the largest tooling area ever devised. In addition, the W3001 offers many other advantages which will help spring-makers boost their production of torsion springs and reduce their costs at the same time.

*• Tooling area measures 12" by 18" • Tooling is faster and easier • Tools themselves can be made sturdier and more durable • Shafts on 3 sides plus vertical 2-slide attachment give great versatility in producing complex forms • Capacity extends to 10 turns of .080" wire, thus meeting the great majority of customer requirements for torsion springs • Rugged design means years of trouble-free operation with minimum downtime for maintenance and repairs.*

The Torrington Manufacturing Company has built more spring coiling machinery since 1937 than all other manufacturers combined. The knowledge and skill gained while serving spring makers during this period has now been used to create a torsion winder which we firmly believe is the finest ever offered to the industry. If you manufacture torsion springs, this new machine will give you faster, more efficient production and unprecedented versatility to meet your customers' most exacting needs.

Call or write, *now,* for full information.

*See the Torrington exhibit at the National Metals Exposition, November 1 to 5. Booth 2060, International Amphitheatre, Chicago.*

THE
**TORRINGTON**
**MANUFACTURING COMPANY**
TORRINGTON · CONNECTICUT
WIRE FORMING MACHINERY DIVISION

# For the FINEST Dies...

*Specify*

## There Are Many Reasons Why V-R Leads The Field!

V-R NEW Cylindrical nib and improved method of assembly insure high degree of concentricity.

V-R . . . First in producing the only Tantalum-Tungsten carbide developed specifically for Drawing Dies.

V-R . . . First to manufacture Carbide Dies with preformed rough cored back relief.

V-R . . . First to furnish Carbide Dies rough cored to finish at hole sizes below .010".

WRITE TODAY for NEW Vascoloy-Ramet Die Catalog VR-461.

The New V-R Die Catalog gives complete ordering information on all V-R Dies for drawing wire, rod, bar and tube.

VASCOLOY-RAMET CORPORATION
[illegible] STREET
WAUKEGAN, ILLINOIS

# The Wire Outlook

The nation's steel capacity for this year will be almost 126 million net tons. This is 34 million tons, or 37 per cent, more than we could have produced nine years ago. One and a half million tons of this was added in 1954. Over 6 billion dollars has been invested by the companies in new equipment and construction in the post-war period and it is estimated that $695 millions will be spent in 1955. Thus does private enterprise reach out to provide for the future.

There has been much bluff and bluster on the part of the Communists, but the official feeling in Washington is that neither Russia nor China will take the chance of losing everything by starting an actual fight. Their tough talk arises mostly from weakness—not strength. We have to keep in mind, however, that we are dealing with fanatics who might, in their zeal, overstep the bounds of good judgment.

Consumer spending is high and cars, particularly, are selling well. The stock market continues to edge up and at the close of the year should be considerably higher, because of the better profit outlook. Money is tightening a little, especially on mortgages, but this is banker inspired—not Government. Installment buying is on the increase and borrowing is up. At the close of the year individuals owed some $30 billions for purchased goods.

While wage and salary income dipped slightly in December, they are now increasing, partly due to higher pay and partly because of increased employment. The record holiday trade has been maintained, which augurs well for continued good business. January retail sales averaged nearly 10 per cent higher than a year ago. Home and commercial construction continued through the Winter months at exceptionally high levels.

On the debit side of the ledger is the disturbing threat of the CIO to press for the repeal of the Taft-Hartley waiver, which gives to the states the authority to outlaw compulsory unionism, and the continued insistence upon a guaranteed annual wage. This latter is to be the number-one demand in the Spring contract negotiations—backed by a $25 million strike fund.

We believe that nothing is more important to the American way of life than the freedom of the individual to seek employment of his own choosing and to be able to work without being required to join a union. As to the guaranteed annual wage, it is nice sounding, but many a company's total assets could be eaten away by it in a matter of months. Then where would the security of labor be?

Copper supply again poses a problem. It looks like a one million ton domestic production year, but demand has been increasing and the supply dwindling. The difficulty arises principally from strikes that shut down mines in South America and Africa. About 11,000 tons per month more copper is needed to maintain 1954 production levels. To somewhat offset this, the Government has banned the export of new copper and limited the export of scrap.

A noticeable pickup in the demand for merchant wire products is reported. Manufacturers' wire sales are strong. Construction wire products are moving better, with excellent backlogs for welded wire mesh for highways on producers' books. Railing strand orders are also reported good.

With good business certain for the Winter and Spring months, the momentum of the upturn should assure us of high levels of activity at least through the Spring of 1956. And if the long-awaited tax cuts come in 1956, consumers will have more wherewithal to help keep business on an even keel.

—from the Editor's Desk

You have to get up early in the morning

for a drawing powder as good as

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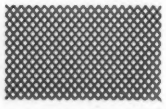

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Vol. 30 March, 1955 No. 3

# AC or DC Spooler Drives for Wire Enameling Equipment

by Richard Bliss
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**This article provides information on spooler drives for enameling equipment based on studies conducted by the author's company. The object is to indicate the types of drives for various operating conditions that will give the manufacturer the greatest possible efficiency.**

**Electric** wire winding machinery has found an increasing application for winding wire on wire enameling equipment. More uniform winding, lower maintenance and less operator attention are characteristics of electric winding drives which have resulted in greater user acceptance in wire enameling mills.

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**Electric** winding systems are available in a number of different varieties. For instance a spooler for a wire enameling machine may be powered by either an AC motor drive or a DC motor drive.

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**The** question arises which drive is better. Equipment users ask "Why should one drive be preferred over another?"

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**There** are good and sufficient reasons for the selection of one drive over another. From a user's standpoint, it depends on how much improvement he can get in his winding equipment in relation to its cost. Table 1 shows the results of a study in which the costs of various systems are compared with the improvement in winding which might be realized for each system. This article is a detailed discussion of the subject.

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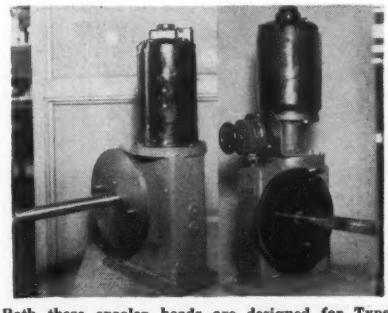

**Both these spooler heads are designed for Type M wire enameling takeups. The one on the right uses an AC motor, and the one on the left has a DC motor. When should each be used and why? * * * * * * ***

**TABLE 1**

EQUIPMENT COST AND PERFORMANCE COMPARISON FOR WIRE ENAMELING SPOOLER DRIVES

| Type Of Drive | Additional Cost Over Lowest Cost System | Improvement In Winding |
|---|---|---|
| AC - (High Torque) | Base | Base |
| AC - (Stalled Torque) | 2.5% | 15% |
| AC - (Wound Rotor) | 5 % | 17% |
| DC - (Series Wound) | 10 % | 56% |
| AC - (High Torque, High Slip) ( Dual Frequency ) | 15 % | 25% |
| AC - (Wound Rotor ) (Dual Frequency) | 21 % | 38% |
| AC - (High Torque, High Slip) ( Adjustable Frequency ) | 21 % | 36% |
| AC - ( Wound Rotor ) (Adjustable Frequency) | 29 % | 43% |

**Let** us use a typical equipment design problem to illustrate the characteristics of the various drives and to analyze the cost of the respective equipment.

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**Such** a problem would be the design of a wire reeling equipment for a Type M enameling machine. The equipment purchaser would specify the reels upon which he wishes to wind wire for this application, as illustrated in Table 2. The Type M wire enameling equipment denotes a certain range of wire sizes. Limitations of the enameling process dictate the speed at which the wire will be

TABLE 2

PICKUP REEL DIMENSIONS:

FOR TYPE M WIRE ENAMELING MACHINE

| | | | | | |
|---|---|---|---|---|---|
| Flange Dia. | - | 12" | - | 16" | - | 24" |
| Barrel Dia. | - | 6" | - | 8" | - | 14" |
| Bore Dia. | - | 1 1/2" | - | 1 1/2" | - | 1 1/2" |
| Overall Width | - | 8" | - | 8 1/2" | - | 8" |
| Flange Thickness | - | 1" | - | 1 1/4" | - | 1 1/16" |
| Traverse | - | 6" | - | 6" | - | 6" |
| Dog Radius | - | 2 1/2" | - | 3" | - | 3" |
| Dog Hole | - | 5/8" | - | 3/4" | - | 3/4" |

run in these machines. A typical wire size, wire speed set-up for a Type M wire enameling machine would be as listed in Table 3.

TABLE #3

WIRE SPEEDS

FOR TYPE M WIRE ENAMELING MACHINE

| Wire Size AWG | Wire Speed FPM |
|---|---|
| #23 | 70 |
| 22 | 65 |
| 21 | 59 |
| 20 | 54 |
| 19 | 48 |
| 18 | 43 |
| 17 | 38 |
| 16 | 36 |
| 15 | 33 |

**Wire** tensions must first be determined in order to calculate the requirements of the drive. Experience has shown that annealed copper wire, produced by a wire enameling machine, should be spooled at a top tension of about 7500 pounds per square inch cross section. Practical experience has also shown that better spooling is realized if tension fall-off during windings is kept under 30% from the original value. These two tension figures, factored into wire dimensions, give the designer the allowable wire tensions as listed in Table 4.

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**Since** winding wire is a rotational physical problem, the winding requirements must be expressed in rotational speed, RPM, and torque, pound-inches. The acceptable tension limitations are factored with wire speed and spool size to give a series of speed and torque values. These figures are then plotted on curve paper using torque as the abscissa and spindle speed of the ordinate as shown in Curve #1. For each spool condition and each wire size at its particular speed, a smooth curve can be drawn to represent the winding characteristics. The winding characteristic is plotted as a constant tension winding, in solid line and the 30% allowable variation is also shown, plotted in dotted lines.

TABLE #4

WIRE TENSIONS:

FOR TYPE M WIRE REELING MACHINE

| | Wire Tension: | |
|---|---|---|
| Reeling Stress - Psi → | 7500 | 5250 (-30%) |
| Wire Size AWG | Area Sq. Mil | Lbs. | Lbs. |
| 23 | 401 | 3.0 | 2.1 |
| 22 | 503 | 3.76 | 2.63 |
| 21 | 638 | 4.78 | 3.35 |
| 20 | 804 | 6.02 | 4.22 |
| 19 | 1012 | 7.6 | 5.32 |
| 18 | 1280 | 9.6 | 6.72 |
| 17 | 1610 | 12.1 | 8.48 |
| 16 | 2030 | 15.2 | 10.63 |
| 15 | 2560 | 20.0 | 14.0 |

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**This** curve is interpreted as follows: The solid constant tension line and the dotted allowable variation line tend to form a rough triangle for each particular wire size and each particular spool. The maximum speed point is the start of winding in each case, where the wire is fastened to the barrel of the spool. As wire builds up on the spool, the spool must slow down to compensate for increased fill while still holding constant wire speed.

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**The** winding performance requirement is now expressed in curve form. The problem before the designer now is to select a drive to fit these characteristics.

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**Wire** enameling machines are generally multi - line machines. They may have as many as 20 lines or 24 lines of wire or sometimes more. Because of the large number of lines, motors and control must be kept to the minimum to avoid excessive equipment cost.

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**This** reason basically dictates that any drive for a wire enameling machine should be what is called an "unregulated" type of drive. This is defined as a type of spooling drive in which the winding performance requirement is produced by the inherent characteristics of the drive itself. It also denotes that this performance will be kept within desired limits by the inherent characteristics of the drive rather than by any external, torque regulating, feedback system such an operator adjusting tension, dancer rolls on the wire, or similar device. The basic problem is to find drive characteristics that match the spooler requirement.

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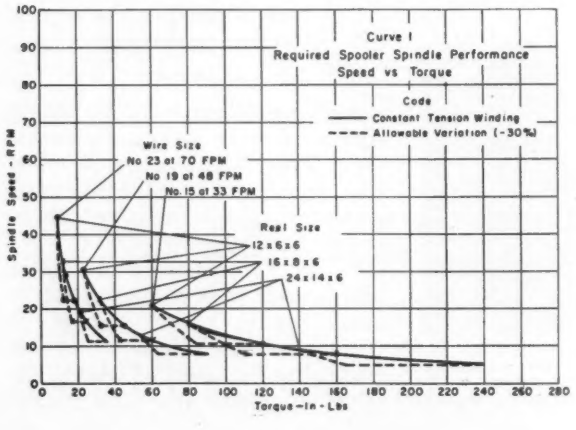
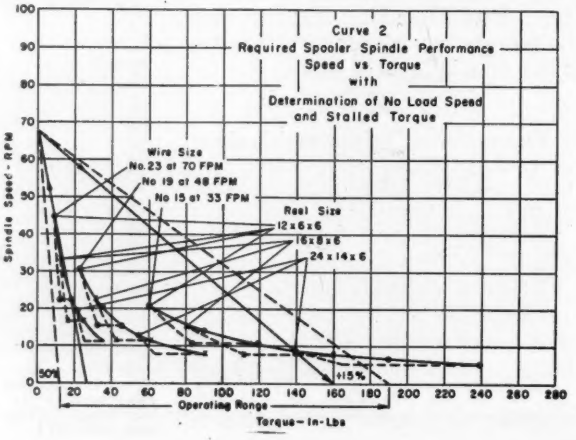
**The** equipment designer must make an initial selection of motor sizes before proceeding with a drive analysis. Curve #2 illustrates how this is done. The end points of the spooling curve for the smallest wire size on the



smallest spool are linked with a straight line which is projected to the spindle speed ordinate line. This gives a tentative design value of no load speed for the spindle drive. A straight line is then drawn through the tentative no load speed to the point representing the start of spooling for the heaviest size wire on the largest spool. This line is in turn projected to the abscissa of the curve to give a tentative design value of stalled torque required of the spooler drive. These values are then converted, with proper allowance for drive friction, to values of motor speed and motor torque, which are then used in the selection or design of the proper spooler motor.

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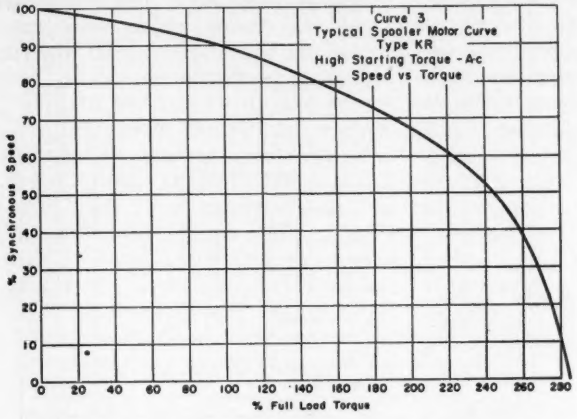
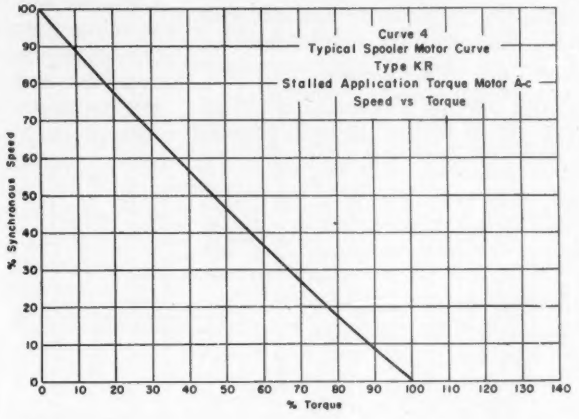
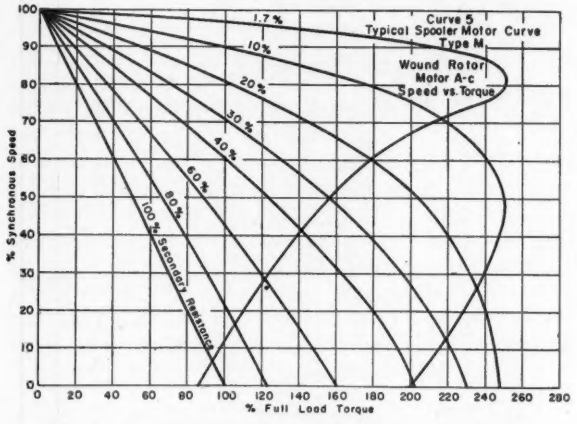
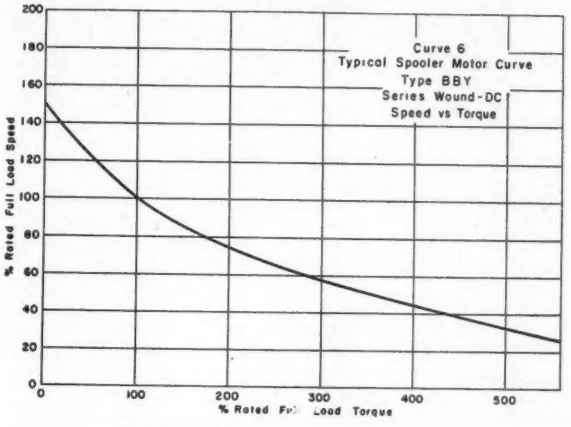
A preliminary search of motor characteristic curves produces some possibilities of motors whose characteristics are somewhat similar to the spooling requirements. These possibilities would be a high starting torque AC induction motor with a basic characteristic as shown on Curve 3, a stalled torque AC induction motor with basic characteristic shown on Curve 4, a wound rotor AC induction motor with a characteristic as shown on Curve 5, and a series wound, direct current motor, having characteristics as shown in Curve 6.

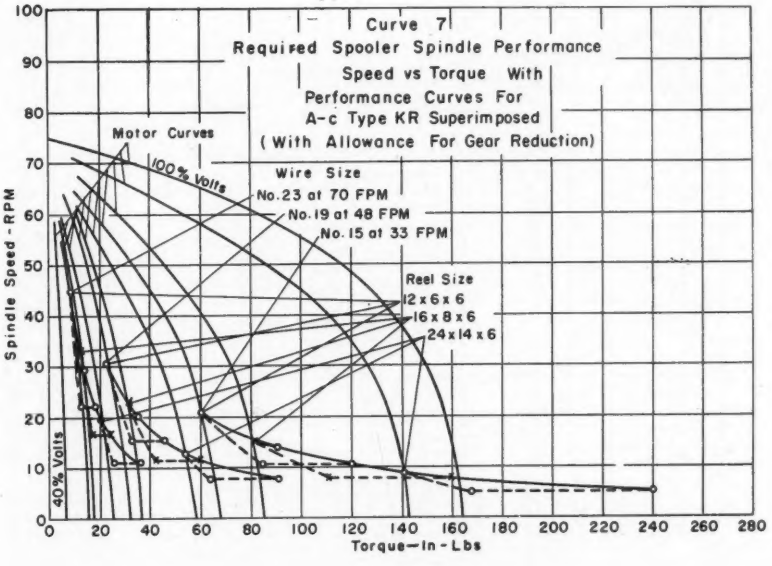
The high torque motor and the direct current motor have single characteristic curve lines at rated voltage. The wound rotor motor, however, has a characteristic consisting of a family of curves. The shape of each curve depends on the secondary circuit resistance and will have a characteristic of nearly



a straight line as shown by the 80% and the 100% resistance curves on Curve #4.

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In order to analyze the performance of these motors with respect to the spooling characteristics, it is necessary for the designer to select motors of each type and compare its particular characteristics with the winding requirement.

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In Curve #7 a typical high starting torque motor has been selected and its performance co-plotted with the winding requirement. It is noted that the output of this motor between a maximum of 100% and a minimum of 40% rated volts will cover the most of the range of the spooling requirement. However, it will be noted that the bend in the curves is in the opposite direction from the bend of the winding requirement. The difference between the superimposed motor line and the original winding requirement represents the deviation in winding tension which will be realized with this type of drive. In each case an operating voltage line has been drawn through the starting point of the curve of spooling for a particular wire and spool size. The tension, as expressed in torque at the end of winding, which is the low speed end of each spooling curve, can then be calculated and compared with the desired value, as represented by the original solid line for spooling performance.

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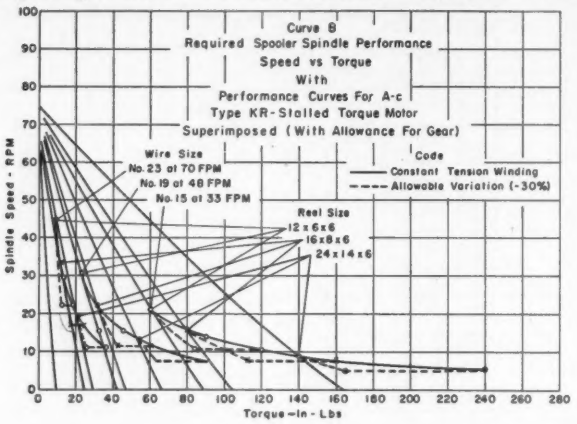
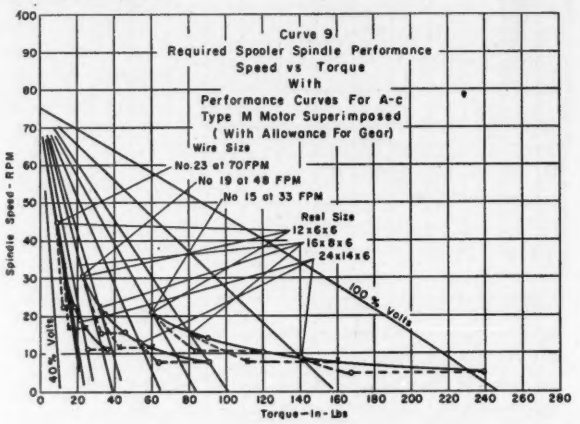
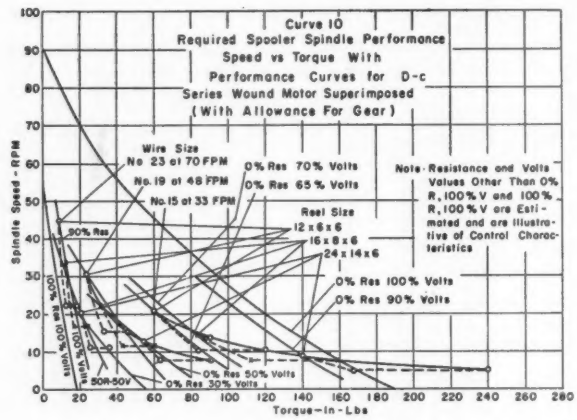
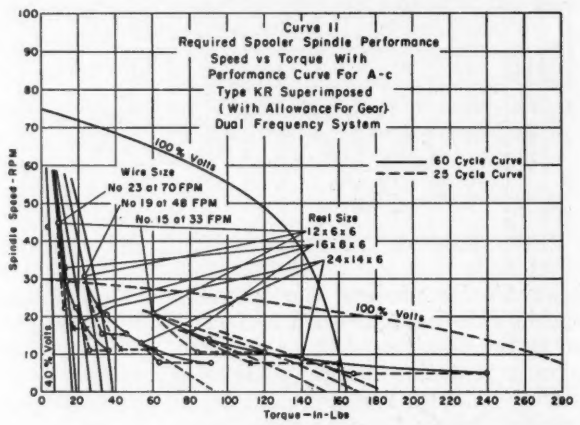
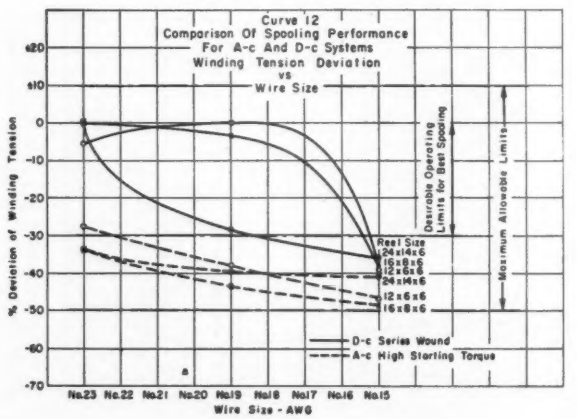
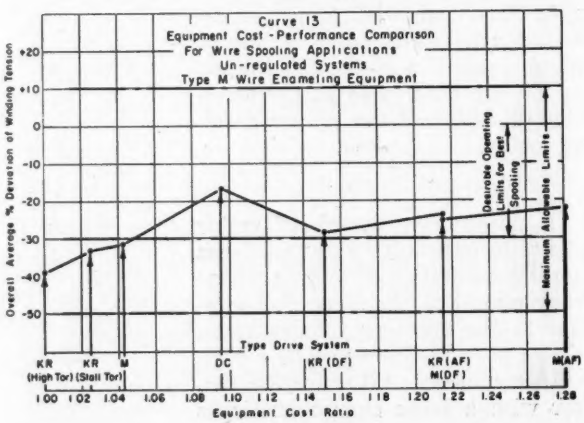




Curve 10
Required Spooler Spindle Performance
Speed vs Torque With
Performance Curves for D-c
Series Wound Motor Superimposed
(With Allowance For Gear)
Spindle Speed - RPM
Torque-In-Lbs
Wire Size
No. 23 at 70 FPM
No. 19 at 48 FPM
No. 15 at 33 FPM
0% Res 70% Volts
0% Res 65% Volts
Note - Resistance and Volts Values Other Than 0% R, 100% V and 100% R, 100% V are Estimated and are Illustrative of Control Characteristics
Reel Size
12x6x6
16x8x6
24x14x6
90% Res.
0% Res 100% Volts
0% Res 90% Volts
0% Res 50% Volts
0% Res 30% Volts



**In** similar manner a stalled torque motor, a wound rotor motor are selected, and their characteristics superimposed on the winding performance curve with the results as shown in Curves 8 and 9. It will be noted that the straight line characteristic, of the wound rotor motor and the stalled torque motor more closely approach the winding requirement curves.

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**Curve** #10 is a third case where the DC, series wound motor characteristics are superimposed on the winding requirement curves. It will be noted that in this case the basic curve of the motor much more closely approximates the shape of the winding requirement. This basic curve can be easily altered to different slopes by the adjustment of external series resistance.

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**Further** analysis of the alternating current motor characteristic correlation indicates that much better performance might be expected if the characteristic motor curve could be arranged for a lower speed, higher torque curve. This would more closely approximate the heavy wire sizes on large spools. This can be done with mechanical gear changing transmissions for each spindle or, it can be done electrically with a dual frequency control system or an adjustable frequency control system.

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**In** Curve #11 the basic motor curve, operating at 60 cycles, is plotted on the winding requirement. Also plotted is the characteristic curve for the same motor when operating on 25 cycles. It will be noted that the second frequency changes the slope of the curve considerably and places it in closer correlation with the larger wire sizes on heavy spools. Extreme care must be taken in using a dual frequency system to select oversize motors which will allow enough heat dissipation capacity as required in lowering frequency on induction motors. Unfortunately this tends to raise the cost of the equipment, since larger motors must be provided.

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**An** adjustable frequency-alternating current spooler drive system would have characteristics similar to the dual frequency except that it has a wider field of application.

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**The** performance of each particular type of drive is analyzed in terms of a percentage of deviation of actual winding conditions from constant winding tension. The complete analysis for the drives covered by this discussion is shown on Table 5.

**Curve** #10 shows the basic comparison between the cheapest AC system, high torque, high slip induction motor and the DC, series wound motor system. Curve #12 indicates some of the advantages of the DC drive over the AC drive. For the given application, more wire sizes of the particular range on a greater number of spools are spooled within the most desirable operating limits of zero to minus 30% deviation of winding tension. The high torque motor characteristics are such that its winding performance produces deviations from about 30% to 50% less than the original winding tension. In effect, the winding characteristic is not too much better than a mechanical type slip clutch wire spooling drive, where the wire tension varies directly with build of the wire on the spool. A variation in tension of this magnitude could cause the outer layers of wire to be wound in a "soft" or "spongy" fashion.

TABLE #6

PERFORMANCE - COST COMPARISON

| Type System | Cost Ratio | Av. Winding Deviation |
|---|---|---|
| HR (High Start Torque | 1.0 | -39% |
| KR (Stalled Torque) | 1.025 | -33.1 |
| M | 1.043 | -31.8 |
| DC | 1.095 | -16.7 |
| KR (DF) | 1.151 | -28.6 |
| M (DF) | 1.215 | -23.8 |
| KR (AF) | 1.215 | -25. (est.) |
| M (AF) | 1.285 | -22. (est.) |

**The** other side of the coin is how much the equipment costs will vary in relation to the performance of the machine. Table 6 lists the

(*Please turn to page* 348)

TABLE 5 WINDING PERFORMANCE ANALYSIS:

| Reel Size | Wire Size | KR W | KR M | KR -% | KR (Stalled Torque) W | KR (Stalled Torque) M | KR (Stalled Torque) -% | M W | M M | M -% | DC W | DC M | DC -% | KR (Dual) W | KR (Dual) M | KR (Dual) -% | M (Dual Freq.) W | M (Dual Freq.) M | M (Dual Freq.) -% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 24X14X6 | 23 | 36 | 24 | 33.5 | 36 | 26 | 28.0 | 36 | 25 | 30.5 | 36 | 36 | 0 | 36 | 24 | 33.4 | | | |
| | 19 | 91 | 55 | 39.5 | 91 | 59 | 35.2 | 91 | 58 | 36.3 | 91 | 65 | 28.5 | 91 | 70 | 23.1 | | | |
| | 15 | 240 | 142 | 40.7 | 240 | 150 | 37.5 | 240 | 148 | 38.3 | 240 | 154 | 35.9 | 240 | 161 | 33.0 | | | |
| | Av. | | | 37.9 | | | 33.6 | | | 35.1 | | | 21.5 | | | 29.8 | | | 27.3 |
| 16X8X6 | 23 | 24 | 16 | 33.5 | 24 | 18 | 35.0 | 24 | 17 | 29.3 | 24 | 24 | 0 | 24 | 15 | 37.5 | | | |
| | 19 | 60 | 34 | 43.3 | 60 | 39 | 35.0 | 60 | 39 | 35.0 | 60 | 58 | 3.3 | 60 | 35 | 41.8 | | | |
| | 15 | 160 | 83 | 48.1 | 160 | 92 | 42.5 | 160 | 90 | 43.8 | 160 | 100 | 37.4 | 160 | 119 | 25.7 | | | |
| | Av. | | | 41.6 | | | 37.5 | | | 36.1 | | | 13.6 | | | 35.0 | | | 30.4 |
| 12X6X6 | 24 | 18 | 13 | 27.8 | 18 | 18 | 0 | 18 | 16 | 11.0 | 18 | 17 | 5.6 | 18 | 13 | 27.8 | | | |
| | 19 | 45 | 28 | 37.8 | 45 | 33 | 36.7 | 45 | 31 | 31.2 | 45 | 45 | 0 | 45 | 29 | 35.5 | | | |
| | 15 | 120 | 64 | 46.6 | 120 | 74 | 48.4 | 120 | 73 | 39.3 | 120 | 85 | 39.0 | 120 | 120 | 0 | | | |
| | Av. | | | 37.4 | | | 28.3 | | | 24.4 | | | 14.9 | | | 21.1 | | | 13.7 |
| Overall Average | | | | 39.0 | | | 33.1 | | | 31.8 | | | 16.7 | | | 28.6 | | | 23.8 |

Approximately Same Ratio as M/KR Systems

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# Hot Dip Galvanizing Is A Science

by Wallace G. Imhoff, President
The Wallace G. Imhoff Company
Los Angeles, California

Part II

**Scientific principle number one was discussed in Part 1. Principle number two is that the heavier the gage of the base metal, the heavier the zinc deposited as a galvanized coating; and the principle number three is that the longer the submersion time in the molten zinc bath the heavier will be the zinc deposited as a galvanized coating. These two last principles are discussed in this Part II of Mr. Imhoff's series. The author is a well-known consultant on galvanizing and plans to cover the entire subject of galvanizing in this series. The next of which will appear shortly.**

It was mentioned previously that the main reason why the practical galvanizer could very easily misinterpret the results of his galvanizing operations, was because the many scientific principles of galvanizing do not always operate in the same direction, and that always some of the principles are functioning in direct opposition to other principles. This accounts for the whole galvanizing industry believing that the higher the galvanizing bath temperature was carried, the lighter the zinc would be deposited as galvanized coating. It was not until actual laboratory research investigations, backed up with plant verification of the laboratory findings, proved conclusively that exactly the opposite was true, namely, the higher the galvanizing bath temperature, the heavier the zinc will be deposited as galvanized coating.

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Once again this focuses attention on how difficult it is to get the true facts and principles with two opposing forces always operating to increase or decrease the results of the opposing force. This in itself makes the true principles hard to discover, but in addition to the principles opposing each other, many times two or more principles operating in the same direction tend to make it very difficult to separate each of these principles, and see what is happening as a result of each of the principles operating alone. It will be noted that at this time, principles number two and number three, are both given at the same time. It is for the reason just stated above that this is done. Attention is called to the fact that an increase in the gage of the base metal, increases the zinc deposited as well as a longer submersion time. It thus becomes necessary to prove that both of these principles operating in the same direction are true.

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Because of the extreme difficulty of clearly proving the results of these two principles, the full details of the research investigation will be submitted, with the actual figures that show the results, and prove that the principles do operate as given. An examination of the figures also show how closely both principles are tied together; in fact as one principle is proved, the other principle is also proved. Full details and figures obtained arranged in orderly tables, illustrate this fact.

## 1. Base Metal Used:

The material used for these research tests was one-pass cold-rolled, 6-inch square sheets. The gages used were 14, 24, 26, 28, 29, and 30. The test was made in sets of ten sheets for each gage and each submersion time. The sheets were cold-rolled to remove the ragged edges caused by the shears and to give the sheets a smooth finish.

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This research investigation was made for the following purpose:

1. **To find out how the thickness of the base metal affected the weight of zinc deposited as galvanized coating.**
2. **To ascertain how the submersion time in the molten zinc bath affected the weight of zinc deposited as galvanized coating.**

## 2. Method of Procedure:

Each sheet was carefully weighed black as received. It was then weighed wet in a balanced pan of water. It was next pickled and weighed wet, and finally it was weighed again after galvanizing. The difference between the dry black weight and the wet black weight gave the amount of water it took to wet the sheet, the difference between the wet black weight and the wet weight after pickling gave the amount of scale removed by the pickle; the wet pickled weight minus the water gave the dry pickled weight; and the weight after galvanizing minus the dry pickled weight gave the weight of zinc deposited as galvanized coating.

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The sheets were pickled in a 4 per cent sulphuric acid bath at 180 degrees F. until all of the scale was removed. They were then stood in a water storage vat and finally dipped in a muriatic acid bath just before galvanizing. The temperature of the pickling bath was 180 degress F., and the pickling time averaged four to six minutes.

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In order to smooth out and give an average figure for each test, 10 sheets were galvanized and the results were averaged into one figure for accuracy. Regardless of how careful all operations are conducted, there still are variables that appear, even though every single thing has been carried out exactly as other tests in the same series. The variations may be due to the differences in the surfaces of the different sheets, or, as every practical galvanizer knows, it may be due to the difference in starting conditions and those after the operations have gotten well under way. There is no way to eliminate

WEIGHTS FOR ONE-PASS COLD-ROLLED SHEETS - ( All weights are in grams)

24 - GAGE O.P.C.R.

| No. | Black | Wet | Water | Pickled | Scale | Time | Dry Pickled | Galvanized | Zinc | Time |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 381.80 | 383.60 | 1.40 | 380.50 | 2.10 | 7 Min. | 379.10 | 401.00 | 21.90 | 10 Sec. |
| 2 | 359.80 | 361.10 | 1.30 | 358.90 | 2.20 | 5 " | 357.60 | 376.80 | 18.60 | 20 " |
| 3 | 357.50 | 358.70 | 1.20 | 356.40 | 2.30 | 5 " | 355.20 | 375.80 | 20.60 | 30 " |
| 4 | 382.00 | 383.50 | 1.50 | 381.40 | 2.10 | 5 " | 379.90 | 401.80 | 21.90 | 40 " |
| 5 | 385.40 | 387.20 | 1.80 | 384.80 | 2.40 | 5 " | 383.00 | 406.20 | 23.20 | 50 " |
| 6 | 370.80 | 372.60 | 1.80 | 370.40 | 2.20 | 5 " | 368.20 | 393.30 | 24.50 | 60 " |
| 7 | 374.80 | 376.30 | 1.50 | 373.80 | 2.50 | 6 " | 371.30 | 396.50 | 25.20 | 70 " |
| 8 | 379.00 | 380.50 | 1.50 | 377.60 | 2.90 | 5 " | 376.10 | 401.90 | 25.80 | 80 " |

24 - GAGE O.P.C.R.

| No. | Black | Wet | Water | Pickled | Scale | Time | Dry Pickled | Galvanized | Zinc | Time |
|---|---|---|---|---|---|---|---|---|---|---|
| 1. | 117.20 | 118.40 | 1.20 | 114.30 | 4.10 | 7 Min. | 113.10 | 131.10 | 18.00 | 10 Sec. |
| 2. | 109.50 | 110.70 | 1.20 | 107.90 | 2.80 | 6 " | 106.70 | 124.80 | 18.10 | 20 " |
| 3. | 104.90 | 106.10 | 1.20 | 103.20 | 2.90 | 5 " | 102.00 | 120.20 | 18.20 | 30 " |
| 4. | 117.20 | 118.40 | 1.20 | 116.50 | 1.90 | 6 " | 115.30 | 136.20 | 20.90 | 40 " |
| 5. | 116.90 | 118.50 | 1.60 | 116.50 | 2.00 | 5 " | 114.98 | 138.70 | 23.80 | 50 " |
| 6. | 116.50 | 117.70 | 1.20 | 116.50 | 1.20 | 7 " | 115.30 | 139.10 | 23.80 | 60 " |
| 7. | 117.00 | 118.30 | 1.30 | 116.90 | 1.40 | 6 " | 115.60 | 141.20 | 25.60 | 70 " |
| 8. | 113.00 | 114.40 | 1.40 | 112.50 | 1.90 | 6 " | 111.10 | 138.80 | 27.70 | 80 " |
| 9. | 116.00 | 117.60 | 1.60 | 116.00 | 1.60 | 5 " | 114.40 | 141.00 | 26.60 | 90 " |
| 10. | 117.30 | 118.70 | 1.40 | 117.20 | 1.50 | 6 " | 115.80 | 142.80 | 27.00 | 100 " |
| 11. | 115.80 | 117.50 | 1.70 | 115.90 | 1.60 | 5 " | 114.30 | 142.20 | 28.00 | 110 " |
| 12. | 116.90 | 118.50 | 1.60 | 117.20 | 1.30 | 4 " | 115.60 | 144.90 | 29.30 | 120 " |

All weights in grams

26 GAGE O.P.C.R.

| No. | Black | Wet | Water | Pickled | Scale | Time | Dry Pickled | Galvanized | Zinc | Time |
|---|---|---|---|---|---|---|---|---|---|---|
| 1. | 83.95 | 85.20 | 1.25 | 81.70 | 3.50 | 11 Min. | 80.45 | 98.10 | 17.65 | 10 Sec. |
| 2. | 85.50 | 89.90 | .40 | 83.90 | 2.00 | 10 " | 83.50 | 100.40 | 16.90 | 20 " |
| 3. | 88.70 | 90.40 | 1.70 | 88.90 | 1.50 | 8 " | 87.20 | 105.20 | 18.00 | 30 " |
| 4. | 88.40 | 89.70 | 1.30 | 88.70 | 1.00 | 7 " | 87.40 | 105.00 | 17.60 | 40 " |
| 5. | 88.40 | 90.00 | 1.60 | 88.20 | 1.80 | 7 " | 86.60 | 107.90 | 21.30 | 50 " |
| 6. | 88.90 | 90.50 | 1.60 | 88.30 | 2.20 | 7 " | 86.70 | 107.10 | 20.40 | 60 " |
| 7. | 86.60 | 88.50 | 1.90 | 87.20 | 1.30 | 6 " | 85.30 | 107.00 | 21.70 | 70 " |
| 8. | 90.50 | 92.30 | 1.50 | 90.60 | 1.40 | 6 " | 89.10 | 110.40 | 21.30 | 80 " |
| 9. | 91.00 | 92.70 | 1.70 | 90.70 | 2.00 | 8 " | 89.00 | 111.50 | 22.50 | 90 " |
| 10. | 91.40 | 92.50 | 1.10 | 91.20 | 1.30 | 7 " | 90.10 | 107.10 | 17.00 | 100 " |
| 11. | 90.30 | 92.00 | 1.70 | 90.20 | 1.80 | 10 " | 88.50 | 111.10 | 22.60 | 110 " |
| 12. | 81.20 | 82.60 | 1.40 | 80.20 | 2.40 | 10 " | 78.80 | 103.10 | 24.30 | 120 " |

All weights in grams

28 GAGE O.P.C.R.

| No. | Black | Wet | Water | Pickled | Scale | Time | Dry Pickled | Galvanized | Zinc | Time |
|---|---|---|---|---|---|---|---|---|---|---|
| 1. | 72.70 | 72.20 | 1.50 | 72.10 | 2.10 | 6 Min. | 70.60 | 88.50 | 17.90 | 10 Sec. |
| 2. | 71.50 | 72.50 | 1.00 | 70.30 | 2.20 | 6 " | 69.30 | 86.20 | 16.90 | 20 " |
| 3. | 73.00 | 74.20 | 1.20 | 71.50 | 2.70 | 6 " | 70.30 | 90.50 | 20.20 | 30 " |
| 4. | 74.90 | 75.40 | .50 | 73.30 | 2.10 | 6 " | 72.80 | 91.00 | 18.20 | 40 " |
| 5. | 74.10 | 75.20 | 1.10 | 73.50 | 1.70 | 6 " | 72.40 | 89.70 | 17.30 | 50 " |
| 6. | 74.40 | 74.30 | .90 | 73.30 | 2.00 | 6 " | 72.40 | 92.00 | 19.60 | 60 " |
| 7. | 73.10 | 74.40 | 1.30 | 73.00 | 1.40 | 6 " | 71.70 | 89.50 | 17.80 | 70 " |
| 8. | 74.90 | 75.90 | 1.00 | 74.00 | 1.90 | 6 " | 73.00 | 93.40 | 20.40 | 80 " |
| 9. | 70.80 | 71.90 | 1.10 | 68.90 | 3.00 | 6 " | 67.80 | 88.60 | 20.80 | 90 " |
| 10. | 71.70 | 72.40 | .70 | 70.20 | 2.20 | 6 " | 69.50 | 92.80 | 23.30 | 100" |
| 11. | 71.30 | 72.70 | 1.40 | 70.00 | 2.70 | 6 " | 68.60 | 90.30 | 21.70 | 110" |
| 12. | 72.50 | 73.00 | 1.50 | 70.60 | 2.40 | 6 " | 69.10 | 91.60 | 22.50 | 120" |

All weights in grams

29 GAGE O.P.C.R.

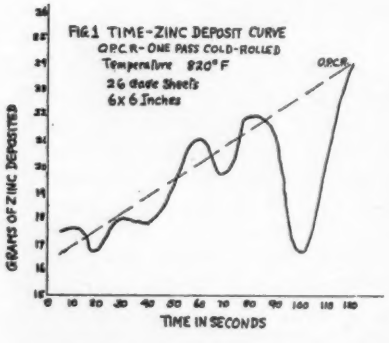
| No. | Black | Wet | Water | Pickled | Scale | Time | Dry Pickled | Galvanized | Zinc | Time |
|---|---|---|---|---|---|---|---|---|---|---|
| 1. | 64.80 | 65.70 | .90 | 63.70 | 2.00 | 6 Min. | 62.80 | 77.70 | 14.90 | 10 Sec. |
| 2. | 65.50 | 67.20 | 1.70 | 64.20 | 3.00 | 6 " | 63.50 | 80.20 | 17.70 | 20 " |
| 3. | 66.30 | 67.50 | 1.20 | 64.70 | 2.80 | 7 " | 63.50 | 83.40 | 19.90 | 30 " |
| 4. | 63.80 | 65.40 | 1.60 | 62.20 | 3.20 | 6 " | 60.60 | 81.00 | 20.40 | 40 " |
| 5. | 64.60 | 66.20 | 1.60 | 64.00 | 2.20 | 8 " | 62.40 | 82.80 | 20.40 | 50 " |
| 6. | 63.20 | 65.00 | 1.80 | 61.80 | 3.20 | 6 " | 60.00 | 82.10 | 22.10 | 60 " |
| 7. | 65.80 | 67.50 | 1.70 | 63.70 | 3.80 | 11 " | 62.00 | 84.70 | 22.70 | 70 " |
| 8. | 64.70 | 66.20 | 1.50 | 62.90 | 3.30 | 13 " | 61.40 | 84.00 | 22.60 | 80 " |
| 9. | 65.10 | 66.30 | 1.20 | 63.50 | 2.80 | 19 " | 62.30 | 83.00 | 20.70 | 90 " |
| 10. | 65.40 | 66.40 | 1.00 | 63.30 | 3.10 | 20 " | 62.30 | 82.80 | 20.50 | 100" |
| 11. | 65.40 | 66.60 | 1.20 | 61.30 | 5.30 | 46 " | 60.10 | 88.30 | 28.20 | 110" |
| 12. | 65.40 | 66.50 | 1.10 | 59.40 | 7.10 | 45 " | 58.30 | 85.60 | 27.30 | 120" |

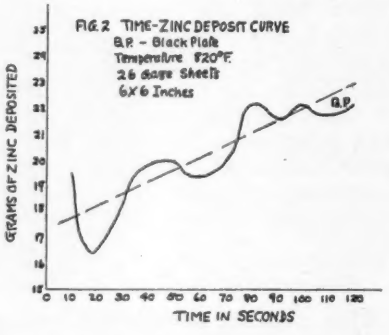
All weights in grams

30 GAGE O.P.C.R.

| No. | Black | Wet | Water | Pickled | Scale | Time | Dry Pickled | Galvanized | Zinc | Time |
|---|---|---|---|---|---|---|---|---|---|---|
| 1. | 56.30 | 57.50 | 1.20 | 54.70 | 2.80 | 10 Min. | 53.50 | 71.50 | 18.00 | 10 Sec. |
| 2. | 55.30 | 56.60 | 1.30 | 54.70 | 1.90 | 5 " | 53.40 | 73.70 | 20.30 | 20 " |
| 3. | 52.40 | 53.70 | 1.30 | 51.40 | 2.30 | 5 " | 50.10 | 70.20 | 20.10 | 30 " |
| 4. | 53.00 | 54.20 | 1.20 | 52.00 | 2.20 | 5 " | 50.80 | 69.70 | 18.90 | 40 " |
| 5. | 52.20 | 53.50 | 1.30 | 52.20 | 1.30 | 5 " | 50.90 | 70.00 | 19.10 | 50 " |
| 6. | 53.00 | 54.10 | 1.10 | 52.20 | 1.90 | 5 " | 51.10 | 71.10 | 20.00 | 60 " |
| 7. | 53.10 | 54.80 | 1.70 | 52.70 | 2.10 | 4 " | 51.00 | 70.90 | 19.90 | 70 " |
| 8/ | 49.60 | 50.80 | 1.20 | 49.00 | 1.80 | 5 " | 47.80 | 69.20 | 21.40 | 80 " |
| 9. | 55.10 | 56.40 | 1.30 | 54.50 | 1.90 | 6 " | 53.20 | 64.00 | 20.80 | 90 " |
| 10. | 57.90 | 59.20 | 1.30 | 56.80 | 2.40 | 3 " | 55.50 | 78.60 | 23.10 | 100" |
| 11. | 51.10 | 52.50 | 1.40 | 49.80 | 2.70 | 6 " | 48.40 | 71.00 | 22.60 | 110" |
| 12. | 50.70 | 52.10 | 1.40 | 50.90 | 1.20 | 4 " | 49.50 | 73.70 | 24.20 | 120" |

All weights in grams

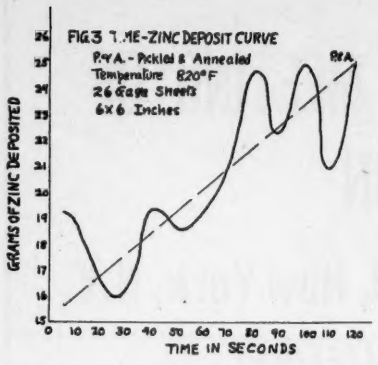


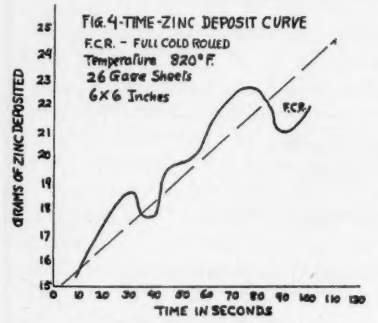



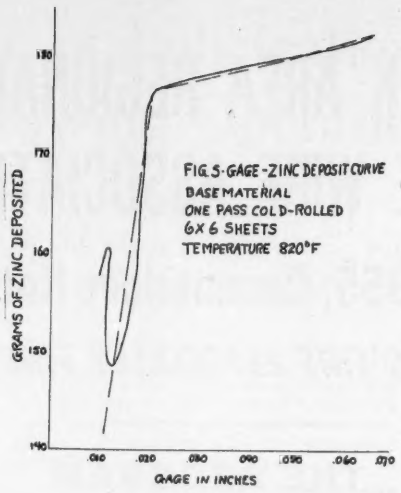

the errors and differences beyond the operator's control. The best precaution to avoid large errors was taken by using the average values obtained from 10 sheets, rather than just one sheet. Even with this precaution there are some fluctuations, but the averages give results that clearly show and prove definite underlying principles are involved in the operations. Once these principles have been discovered, and proved, then the application of the principle can be applied to all galvanizing of the same kind. It establishes order from chaos, and once order and system are established for one principle, others can then be readily discovered.

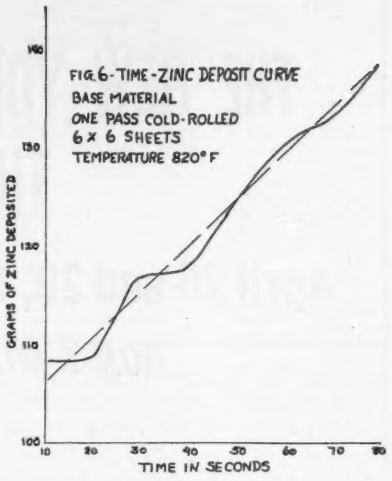
### 3. Galvanizing Operations:

**(a) Submersion Time** — Each set of sheets, 10 in a set, were galvanized a specified time. This time was divided as follows—5 seconds to put the sheet through the flux box, the specified time held in the zinc bath as submersion time, and 5 seconds withdrawal time. The operations were timed with a stopwatch. The dipping and drawing times were kept constant for all sheets. The submersion time varied




in 10-second intervals from 10 seconds to 120 seconds (2 minutes). A set of 10 sheets for each submersion time constituted the test and the results of each ten sheets were averaged into a single weight for the specified submersion time. The zinc bath temperature was 820 degrees Fahrenheit.

* * *

**(b) Gage of Base Metal** — The samples of the base metal were 14, 24, 26, 28, 29, and 30 gage one-pass cold-rolled six-inch square sheets. These sheets were pickled and galvanized in the manner specified above, and the weights were recorded after each operation.

* * *

**(c) Results** — The complete results are shown in the following tables for all sheets, the readings on each line being the average of ten tests.

**TOTAL ZINC DEPOSITED IN GAGES**

**Sum of Zinc Deposited for All Submersion Times**

| | | | | |
|---|---|---|---|---|
| 14 Gage | = | 182.70 grams | .0641 | Inch |
| 24 " | = | 176.10 " | .0201 | " |
| 26 " | = | 154.85 " | .0159 | " |
| 28 " | = | 148.30 " | .0126 | " |
| 29 " | = | 160.70 " | .0113 | " |
| 30 " | = | 157.70 " | .0100 | " |

**TOTAL ZINC DEPOSITED IN TIME**

**Sum of Zinc Deposited on All Gages**

**Time in Seconds**

| Gage | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 |
|---|---|---|---|---|---|---|---|---|
| 14 | 21.90 | 18.60 | 20.60 | 21.90 | 23.20 | 24.50 | 26.20 | 25.80 |
| 24 | 18.00 | 18.10 | 18.20 | 20.90 | 23.80 | 23.80 | 25.60 | 27.70 |
| 26 | 17.65 | 16.90 | 18.00 | 17.60 | 21.30 | 20.40 | 21.70 | 21.30 |
| 28 | 17.90 | 16.90 | 20.20 | 18.20 | 17.30 | 19.60 | 17.80 | 20.40 |
| 29 | 14.90 | 17.70 | 19.90 | 20.40 | 20.40 | 22.10 | 22.70 | 22.60 |
| 30 | 18.00 | 20.30 | 20.10 | 18.90 | 19.10 | 20.00 | 19.90 | 21.40 |
| Total Zinc | 108.35 | 108.50 | 117.00 | 117.90 | 125.10 | 130.40 | 133.90 | 139.20 |

**All weights in grams**

## 4. Conclusions:

The conclusions may be stated definitely as follows:

1. The heavier the gage of the base metal, the heavier the zinc will be deposited as galvanized coating, and vice versa, the lighter the gage of the base metal, the lighter the zinc will be deposited as galvanized coating.
2. The longer the submersion time in the molten zinc bath, the heavier the zinc will be deposited as galvanized coating, and vice versa, the shorter the submersion time in the molten zinc, the lighter the zinc will be deposited as galvanized coating.

## Remarks:

1. The increase in weight of zinc deposited on the number 29 and 30 gage sheets was due to dross formation.
2. The same conclusions are obtained if the base metal is "blackplate," "pickled-and-annealed," or "full-finished" stock.

The New York Area Regional Meeting of The Wire Association has made special provisions to assure the ladies who come with their menfolk of a highly worth-while visit to New York. A representative of The New York Tourist Bureau will be on hand at the registration desk to make arrangements to attend any of New York's many points of interest, including Broadway plays, sightseeing trips, etc.

# THE NEW YORK AREA REGIONAL MEETING OF THE WIRE ASSOCIATION

## April 28 and 29, 1955; Commodore Hotel, New York, N.Y.

***DON'T MISS THIS ESPECIALLY FINE MEETING!***

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## THE PROGRAM

THURSDAY MORNING: 9:00 A.M.—Registration desk opens for members and guests.
10:30 A.M.—Semi-Annual meeting of The Board of Directors.

THURSDAY AFTERNOON: 1:30 P.M.—Technical sessions for Ferrous and Non-Ferrous Divisions.

Ferrous Division Papers:

"Titanium—The Metal and The Industry" by Ward M. Minkler, Asst. Mgr., Market Development, Titanium Metals Corp.
"The Influence of Nail Design and Manufacturing Practices on Joint Strength" by Allan B. Dove, Plant Mgr., Steel Company of Canada Ltd.
"Fabrication of Resistance Alloys" by W. L. Stryker, Chief Process Engineer, Wilbur B. Driver Company.

Non-Ferrous Division Papers:

"Repair of Cable Jackets Using Hot Gas Welding" by Ross Pringle, Chf. Eng., and Andrew Varenelli, Chf. Chem., Ansonia Wire and Cable Company.
"Some Bending Characteristics of 70% Cartridge Brass and 65% Yellow Brass Wire" by Lewis E. Thelin, Asst. Chf. Met., and Robert Abbott, Asst. Genl. Fore., Bristol Brass Co.
"World Supply and Price of Copper" by Bernard Aronson, Pres., Spencer Wire Corp.

THURSDAY EVENING: 6:00 P.M.—Hospitality Hour. Courtesy of the R. H. Miller Co., Homer, N. Y.
7:00 P.M.—Banquet.

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FRIDAY MORNING: 8:30 A.M.—Technical Sessions for Ferrous and Non-Ferrous Divisions.
Joint Ferrous and Non-Ferrous meeting: "Symposium on Aluminum Wire Drawing."

"Aluminum Wire Drawing"—Author to be announced.
"Die Problems in Drawing Aluminum Wire" by Edgar T. Miller, Firth-Sterling, Inc.
"Water Soluble Lubricants for Aluminum Wire Drawing"—Author from Apex Alkali Products Co.
"Dry Lubricants for Drawing Large Diameter Aluminum Wire"—Author to be announced.
"Filtering Lubricants for Aluminum Wire Drawing"—Author from Hercules Filter Corp.

INSULATED WIRE SECTION PAPERS:

"Hycar-HH—General Properties and Electrical Characteristics" by Gerard W. Krucko, Advance Devel. Eng., General Electric Co., and Howard Womack, Devel. Eng., B. F. Goodrich Chemical Co.
"Kel-F Insulation on Wires for High Temperature Applications" by Jules Jupa, M. W. Kellogg Company.
"Wire Insulation with 'Teflon' Tetrafluoroethylene Resin for High Temperature Uses" by Berten E. Ely, Polychemicals Dept., E. I. DuPont de Nemours & Co.
"Inorganic Fibrous Insulations" by E. Q. Harrigan, Continental Wire Company.

10:30 A.M.—Buses leave hotel for tour of General Cable Co. plant at Perth Amboy.
Box luncheon enroute.

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***An interesting program has been arranged for the ladies who come with their men-folk.***

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## THE WIRE ASSOCIATION

**RICHARD E. BROWN, *Executive Secretary***

**453 MAIN STREET** **STAMFORD, CONN.**

# The State of Lubrication in Wire Drawing Operations

by R. Tourret
B.Sc. (Eng), A.M.I. Mech. E., A.F.R.Ae.S., A.F. Inst. Pet:-
Middlesex, England

**This article describes the results of extensive tests of wire drawing lubricants to determine the effects of pressures and temperatures on dies and on the aluminum, brass, copper and steel wire being drawn. The author states his conclusions and offers recommendations.**

## 1. Introduction

**To** perform wire-drawing operations successfully, it is essential to use a lubricant to reduce friction, which would otherwise be excessively high and, in most cases, render the operation impossible. If the lubricants for use in these operations are to be developed systematically it is desirable to have a knowledge of the state of lubrication existing in the wire-drawing dies. Although the pressures and temperatures experienced are high and boundary lubrication might be expected, the geometry is not altogether unfavourable to the formation of a hydrodynamic film.

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**The** best way of evaluating a lubricant is in a full-scale industrial drawbench but this entails too large a research effort for preliminary work. Accordingly, a simple test rig was constructed in which lengths of wire could be drawn through industrial dies in the laboratory. This test work has provided some information on the state of lubrication which exists in wire-drawing operations, which is now reviewed, together with results reported in the literature.

## 2. Vertical Drawbench

### 2.1 Apparatus

**The** Vertical Drawbench (Figs. 1 and 2) was designed to pull five-foot lengths of 15, 16 or 17 S.W.G. wire (Appendix 1) vertically through a die (Appendix 2) by weights fastened to their ends. A moderate reduction in cross-sectional area was used (for convenience, one Standard Wire Gauge to the next) so that the frictional resistance would constitute an appreciable proportion of the total drawing force. The weights employed were sufficient to accelerate the wire to a final velocity of about 650 ft/min., which was considered to be not too far removed from the speeds used in industry.

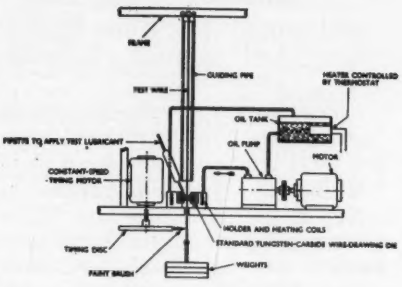


**Figure 1—Sketch of Vertical Drawbench.** * *

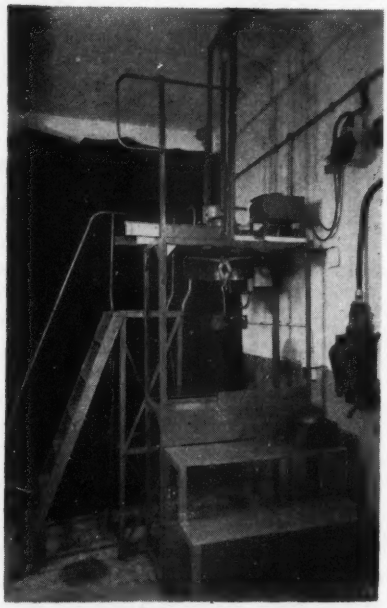

**Figure 2—Vertical Drawbench.** * * * *

**The** rig consisted of a steel framework carrying a cross-member on which the die and auxiliary equipment were mounted. A lighter cross-member above this served as an anchorage for the wire prior to test. The die holder had coils built in it through which hot oil could be circulated to bring it up to temperatures experienced in industry.

### 2.2 Test Method

**The** test wire, previously pointed at one end by forming between grooved rollers, was passed through a pipe which prevented the loose end of the wire from falling over and entering the die at an incorrect angle. The pointed end of the wire was then passed through the die and weights hung on it. The test lubricant was placed in the bell of the die. The wire was then cut at the top and, as it was drawn through the die by the weights, it was marked by a paint-brush attached to the periphery of a disc driven by a constant-speed electric motor. The brush produced marks at small, equal, time intervals; the distance between consecutive marks enabling the average velocity of the wire during those intervals to be calculated. The acceleration of the system composing the wire and weights was less than the acceleration due to gravity since it was reduced by the force due to deformation and friction in the die. From the slope of the velocity/time curve the acceleration and hence the total retarding force of "drawing force" can be calculated.

## 3. Test Results

### 3.1 Effect of drawing speed

**The** acceleration while any particular wire was being drawn (both

copper and aluminium wires were drawn) was sensibly constant. That is, the drawing force or friction was independent of speed, which is characteristic of boundary lubrication*. However, since industrial drawbenches draw wire at speeds in excess of 650 ft/min., it was considered worthwhile making some attempt to attain higher speeds to ascertain if the acceleration remained unaffected by speed even at higher speeds. Accordingly, a temporary test rig, similar in principle to the Vertical Drawbench, was installed at the top of a 60 ft. high water-tank tower. This rig gave speeds of up to about 1600 ft/min. It was found that the acceleration remained constant (only copper was drawn) up to this speed showing that little or no hydrodynamic lubrication occurred even at higher speeds.

* It is possible that as the speed increased the surface temperature increased and offset any beneficial hydrodynamic effect but this would require a rather fine balance between the two effects which is considered unlikely.

### 3.2 Effect of viscosity of lubricant

**In** experiments[1] in which aluminium wire was drawn through a steel die, several straight mineral oils (refined from the same crude by the same process) of different viscosities were used as lubricants. The results (Fig. 3.) showed that a low-viscosity oil required a greater drawing force than a high-viscosity oil, indicating that friction was greater with the light oil.

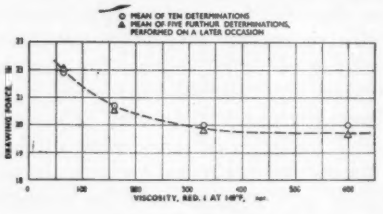
O MEAN OF TEN DETERMINATIONS
Δ MEAN OF FIVE FURTHUR DETERMINATIONS, PERFORMED ON A LATER OCCASION
DRAWING FORCE, lb
VISCOSITY, RED. I AT 140°F.

Figure 3—Influence of viscosity of lubricant on force required to draw aluminum wire, using straight mineral oils. * * * * * *

**Now,** when lubrication is hydrodynamic, the less viscous the fluid, the lower the coefficient of friction and the lower the load which can be carried. On the other hand, in boundary lubrication the viscosity of the fluid does not affect the friction. The phenomenon observed of a decrease of drawing force (friction) with increased viscosity is consistent only with a state of mixed hydrodynamic/boundary lubrication in which the lighter oils, being more readily displaced from between the rubbing surfaces, allow a greater proportion of boundary lubrication to occur, resulting in a greater drawing force.

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**The** state of affairs in mixed hydrodynamic/boundary lubrication has been summarized[2] as:—

$$\mu_o = \alpha\mu_h + (1 - \alpha)\ \mu_b$$

where $\mu_o$ is the observed coefficient of friction

$\mu_h$ is the coefficient of hydrodynamic friction

$\mu_b$ is the coefficient of boundary friction

and $\alpha$ is the proportion of total load carried hydrodynamically.

**Since** the observed change in friction was small compared with the total friction, even for a five-fold increase in the nominal viscosity of the oil used, $\alpha$ must have been small, i. e. only a small proportion of the total load was carried hydrodynamically (so small, in fact that the acceleration for any particular wire appeared constant, see Section 3.1).

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$$\mu_o = \alpha\mu^h + (1 - \alpha)\ \mu_b$$

$\mu$ is the small greek letter Mu
$\alpha$ is the small greek letter Alpha
The sub letters are the English letters, small, O, H and B

**In** similar experiments in which copper wire was drawn through a tungsten-carbide die, viscosity had no effect on the drawing force (friction) which indicates that the hydrodynamic component was negligibly small. Since the force required to draw the copper wire was about three times that required for the aluminium wire, it is perhaps not surprising that the proportion of hydrodynamic lubrication which was small even when drawing the comparatively soft aluminium wire, should be negligible with the harder copper wire. With still harder wire, such as steel, entirely boundary lubrication would be expected.

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**Although** perhaps not strictly a viscosity effect, it is interesting to record here the results of some tests[1] in which soap solution was used to draw copper wire through a tungsten-carbide die. The drawing force (friction) increased rapidly (Fig. 4.) as soon as the soap was diluted with water.

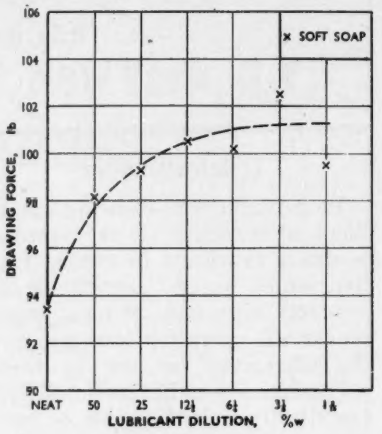


Figure 4—Effect on drawing force required to draw copper wire through a tungsten carbide die when using soft soap diluted to various degrees with water. * * * * * * *

### 3.3 Evidence of metal pick-up from wire to die

**During** the tests in which aluminium wire was drawn through a steel die, on several occasions after a test, the die was first washed in methyl ethyl ketone to remove any traces of lubricant or loose aluminium and then placed in a caustic soda solution to dissolve any remaining aluminium which might be attached to the die. When the die was immersed, a few small bubbles of gas were observed to form, indicating that a very small amount of aluminium had in fact been picked up by the die during the drawing operation. For such metal-to-metal contact to have occurred, the state of lubrication must have been at least partially boundary in character.

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### 3.4 Evidence of pick-up from die to wire

**When** copper wire was drawn through a radioactive tungsten-carbide die [3, 4], particles worn from the die adhered to the wire, again indicating that the state of lubrication was at least partially boundary in character. Indeed, it is apparent from the autoradiographs (which, unfortunately, do

not reproduce well in printing) that some form of wear occurred continuously, indicating that full hydrodynamic lubrication was never established.

### 3.5 Summary of evidence from test results

The experimental results and conclusions derived therefrom are summarized in Table 1.

Table.1.

Summary of Evidence from Test Results.

| Test | Wire material | Die material | Speed of drawing, ft/min | Types of lubricant | Type of lubrication indicated |
|---|---|---|---|---|---|
| Lack of change in drawing acceleration | Copper | Tungsten carbide | zero to about 1600 | All types | Practically entirely boundary |
| | Aluminium | Steel | zero to about 650 | Most types | Mostly boundary |
| Lubricant viscosity effect | Aluminium | Steel | zero to about 650 | Straight mineral oils | Mixed hydrodynamic/boundary |
| | Copper | Tungsten carbide | zero to about 650 | Straight mineral oils | Practically entirely boundary |
| Metal pick-up in die | Aluminium | Steel | zero to about 650 | Aqueous pastes | At least partially boundary |
| Deposits on wire | Copper | Tungsten carbide | zero to about 650 | Aqueous pastes | Practically entirely boundary |

The general conclusion is that when copper is drawn, the state of lubrication is practically entirely boundary; but when aluminium is drawn, the state of lubrication although proponderantly boundary nevertheless has a definite small hydrodynamic component.

## 4. Coefficient of Friction

The coefficient of friction is an index of the state of lubrication in a given set of circumstances. Although the transition from one state to another occurs gradually, the following approximate ranges of coefficient may be applicable (c.f. Papsdorf[5]) :—

| | |
|---|---|
| Pure hydrodynamic | zero to 0.05 |
| Mixed hydrodynamic/boundary | 0.05 to 0.1 |
| Pure boundary | 0.1 upwards |

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Unfortunately it is not easy to make a direct experimental determination of the coefficient of friction in wire-drawing operations because of the difficulty of separating the frictional force from the deformation force. It has been achieved with a revolving die[6] but subsequent work[7] showed that the reliability of the method was doubtful. Another method[8] employed a split die so that the bursting force could be measured as well as the drawing force but this unfortunately proved not entirely satisfactory in practice[9].

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It is not practicable to determine the coefficient of friction accurately by comparing experimental drawing force with theoretical estimates because of probable shortcomings of the theory involved[10]. Nevertheless at least the order of magnitude of the coefficient of friction is indicated and this may be sufficiently accurate to allow the state of lubrication to be inferred. The various values reported for coefficient of friction are given in Table 2. No account is taken in this brief review of factors such as temperatures, die angles, die pressures, etc., which will have some effect on the value of the coefficient of friction.

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Also, Lueg and Treptow[22] have performed a comprehensive series of experiments, unfortunately too lengthy to summarise adequately here, in which 0.53% carbon steel wire was drawn repeatedly at 100 ft/min. As the wire work-hardened and the cross-sectional area decreased, so the pressure generated in the dies increased. The values of the coefficient of friction obtained from a variety of lubricants and lubricant carriers or coatings on the wire, increase from about 0.02 to 0.03 at 75 tons/sq. in. pressure to about 0.08 to 0.10 at 150 tons/sq. in. pressure. These values indicate a state of hydrodynamic lubrication changing as the pressure increases to mixed hydrodynamic/boundary. Eventually the lubricant breaks down giving a rough surface on the drawn wire, symptomatic of extreme boundary conditions.

## 5. Discussion

The experimental results, taken together with the coefficient of friction results from the literature, show that the state of lubrication in normal wire-drawing operations

Table.3.
Physical properties of the wires used for drawing

| Criterion | Units | Wire | | |
|---|---|---|---|---|
| | | Copper | | Aluminium |
| | | 16 S.W.G. | 17 S.W.G. | 17 S.W.G. |
| Ultimate tensile strength | tons/sq.in. | 30.8 | 16.3 | 6.1 |
| Young's Modulus | $10^6$ lb/sq.in. | 19.8 (a) | 14.1 (b) | 10.1 |
| Elongation over one inch | %age | 6.5 | 30 | 11 |

Table.4.
Dimensions of dies used.

| | Dies | | |
|---|---|---|---|
| | 17 S.W.G. commercial tungsten-carbide die | 18 S.W.G. commercial tungsten-carbide die | 18 S.W.G. "homemade" steel die |
| Die semi-angle, degrees | 5 to 6 | 2 to 3 | 4 to 5 |
| Length of bearing, inches | 0.03 to 0.04 | 0.03 to 0.04 | 0.03 to 0.04 |

Table.2.
Summary of coefficient of friction evidence.

| Year | Source | Wire material | Die material | Speed of drawing, ft/min. | Lubricant | Coeefficient of friction | Type of lubrication indicated |
|---|---|---|---|---|---|---|---|
| 1933 | Lewis[11] | Mild steel | Tungsten-carbide | 30 | Soap | 0.09 | Mixed hydrodynamic/boundary |
| 1933 | Thompson[12] | Mild steel | Tungsten-carbide | 1/200 | Soap | 0.07 | Mixed hydrodynamic/boundary |
| | | | | ¼ | Soap | 0.004 (this seems doubtful) | (Hydrodynamic) |
| 1937 | Thompson13 | Mild steel | Tungsten-carbide | 20 to 600 | Various soaps | - | No change in drawing force with speed, therefore boundary. |
| 1938 | Simons[14] | 0.44% carbon steel | Tungsten-carbide | Probably less than 1 | Soap | 0.08 | Mixed hydrodynamic/boundary |
| 1943 | Lueg & Pomp[15] | 0.58% carbon steel | Tungsten-carbide | | "Drawing oil" | 0.05 | Approaching mixed hydrodynamic/boundary |
| 1945 | Lewis[16,17] (industry) | Copper | Steel | Probably 1000 to 2000 | Probably aqueous paste | 0.16 to 0.18 | Pure boundary |
| 1947 | Heselwood (quoted by Wistreich[18]) | Mild steel | Tungsten-carbide | | Soap | 0.05 to 0.06 | Mixed Hydrodynamic/boundary |
| | | 18:8 stainless steel | Tungsten-carbide | | Soap | 0.08 to 0.09 | Mixed hydrodynamic/boundary |
| | | High-carbon steel | Tungsten-carbide | | Soap | 0.09 | Mixed hydrodynamic/boundary |
| | | Red Fox 135 | Tungsten-carbide | | Soap | 0.06 | Mixed hydrodynamic/boundary |
| 1947 | Siebel[19] | Steel | Tungsten-carbide? | | Soap? | 0.02 to 0.15 | Pure hydrodynamic to pure boundary |
| 1950 | Baron & Thompson[20] | 65:35 brass | Tungsten-carbide | Not more than 3½ | Soap | 0.05 to 0.06 (depending on reduction & die angle) | Practically pure hydrodynamic (or psuedo-hydrodynamic) |
| | | | | | Aqueous paste, castor oil and oil-suspended colloidal graphite | 0.07 to 0.09 | Mixed hydrodynamic/boundary |
| | | | | | Hypoid E.P. oil | 0.10 to 0.11 | Approaching pure boundary |
| 1951 | Lueg & Treptow[21] | Steel | Tungsten-carbide? | | Soap | 0.02 to 0.10 | Pure hydrodynamic to mixed hydrodynamic/ boundary |
| 1952 | Cook & Wistreich[10] (photoelasticity studies) | Lead (commercially pure lead alloyed with either 3% or 5% tin) | Stress-optically-sensitive plastic | About 1/12 | Soap | 0.01 to 0.05 | Practically pure hydrodynamic (or psuedo-hydrodynamic) |
| 1952 | Lunt & co-workers (quoted by MacLellan[9]) | Copper | Tungsten-carbide | 1½ | DTD 417A | 0.06 | Mixed hydrodynamic/boundary |
| | | | | | Colza oil | 0.16 | Boundary |
| | | | | | Soap | 0.12 | Boundary |
| | | | Diamond | 1½ | Ethyl palmitate | 0.08 | Mixed hydrodynamic/boundary |
| | | | | | Ethyl stearate | 0.08 | Mixed hydrodynamic/boundary |
| 1952 | MacLellan[9] | Copper | Tungsten-carbide | 1 | Castor oil | 0.16 | Boundary |
| | | | Diamond | 1 | Castor oil | 0.10 to 0.21 (depending on die angle) | Boundary |
| | | | Steel (split) | 1 | Castor oil | 0.15 | Boundary |
| | | | Tungsten-carbide (split) | 1 | Castor oil | 0.08 to 0.10 (depending on die angle) | Approaching pure boundary |

is boundary for most metals, particularly for the harder ones, and that a small proportion of hydrodynamic lubrication giving mixed hydrodynamic/boundary conditions is encountered only with very soft metals such as lead and aluminium.

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**The** state of lubrication also depends on the lubricant. Soap appears to act as a highly viscous fluid or an easily-sheared solid giving with the softer metals practically pure hydrodynamic conditions. With harder metals such as steel the conditions tend towards boundary. Other, less viscous, lubricants, in particular the water-base fluids used for wet-drawing operations, do not gain access to the contact zone so readily because of the high pressures generated, and thus give boundary conditions.

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**The** hydrodynamic or psuedo-hydrodynamic action of soap is confirmed by experiments[20] in which brass wire was drawn through a die, the surface finish of which was altered from smooth to rough. This greatly influenced the coefficient of friction when castor oil was used as a lubricant but had little effect with soap. Thus soap gave hydrodynamic lubrication (i:e. surfaces out of contact and hence finish immaterial), whereas castor oil functioned largely as a boundary lubricant.

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**In** industry, since dies wear quite rapidly and since the performance of a lubricant often depends on the metal drawn and the die material, boundary lubrication is indicated. It is perhaps significant that mineral oil, a poor boundary lubricant, is used for drawing only soft metals such as aluminium[23, 24], a practice which agrees with the experimental result that aluminium drawing can be at least partially hydrodynamic.

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**That** the soap used in industry for drawing steel functions at least partially by hydrodynamic or some analagous form of lubrication is confirmed by the intermittent slivers of soap which often emerge from the die[25]. Even so, die wear is appreciable. Possibly soap is insufficiently fluid for a film to be continuously maintained, so that soap slivers form at times but not at others and die wear will then occur. Since soap is usually applied in a somewhat haphazard manner in industry, by means of lumps, flakes or powder held in a wedge-shaped box through which the wire passes, sometimes picking up soap as it goes, film formation might very well be intermittent. If this is so, then appreciable increases in die life might be obtained by ensuring in some positive manner that soap is applied continuously to the entire surface of the wire. Already it has been shown[26] how a suitable design of die holder can automatically induce the desirable state of hydrodynamic lubrication with a liquid lubricant. It remains for some similar device to be invented which will ensure a continuous film of solid soap on the wire. It may even be worth while force-feeding the soap into the die by separate, special, equipment.

## Appendix. I.

### Details of Wires and Dies Used

**The** following data gives some idea of the physical properties of the wire (Table.3.) and of the dimensions of the dies (Table.4.) used. All wire was tested in the "as received" condition, i. e. drawn.

### Notes

(a) **The** relatively high Modulus of Elasticity is noteworthy, Youngs Modulus for copper being quoted as 16 x $10^6$ lb/sq. in. The higher value recorded on the drawn wire is due to the preferred orientation of the face-centre cubic crystals. Young's Modulus for the [111] direction in the crystal is 2716 x $10^6$ lb/sq. in. and for the [100] direction 9.4 x $10^6$ lb/sq. in. As the crystals in copper tend to take up the [111] position relative to the axis of the wire when drawn rather than the [100] position, the elastic constant will rise accordingly.

(b) **Not** drawn to the same extent since the last anneal as the 16 S.W.G. wire.

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## WIRE AND WIRE PRODUCTS

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# Graphic Analysis of the Relation Between the Wire and Capstan Speeds on Multiple Wire-Drawing Machines

by J. A. Giaro, Dr. of Sc.
Consulting Engineer
Marcinelle-Charleroi, Belgium

**In this treatise the author presents a graphic method developed through his work with various European Cable Works, by which through the use of versatile diagrams the relative speeds of drawing capstans in terms of die diameters may be determined.**

## 1. Introduction

**The** correct knowledge of the mechanical phenomena which occur in a multiple wire-drawing machine is of primordial importance for the efficiency of the machine and even for the quality of the drawn wire. Two groups of phenomena can be distinguished in this kind of machine: the phenomena of the plastic deformation in the dies accompanied by friction between the walls of the dies and the drawn wire, together with the dynamic and kinematic phenomena which take place outside the dies. This division is certainly somewhat arbitrary, but it is sometimes useful and acceptable for our considerations.

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**In** this paper, we shall only attend to the second group of above mentioned phenomena; viz.: those that occur outside the dies, the physics and the mechanics of the phenomena inside the die channel having already formed the subject of numerous publications. We refer in this respect for example to the recent work of **H. G. Baron** and **F. C. Thompson** (1)(x), where very ample bibliographical data will be found regarding this question. The phenomena which we intend examining are relatively simple in nature, but rather complex on the whole. So, for example, it is not easy to see at once or with accuracy all the consequences of changes of the various diameters of the dies or of the drawing capstans, on account of the wearing and of their rectification by grinding.

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**It** can be conceived a priori that the graphic method has to be the more suitable means of such an analysis, provided it is simple and easily established. We hope to be in a position to propose such a method in the present work while leaving our readers to appreciate its useful purpose.

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**To** explain our method of graphic analysis, we have chosen two types of classical multiple wire-drawing machines; viz.: one with slip of the wire over the drawing capstans and the other without slip, but with storage of the wire at each drawing stage. We shall not deal with the machines with compensation or adjustment of the speeds of the drawing capstans, which avoids both the slip and the storage of the wire, these machines being only special cases of the previous ones, from the point of view of kinematics (see ref. [2]).

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**Nor** shall we deal with the back-pull machines; they are as a rule machines with automatic compensation of the speeds of the drawing capstans by means either mechanical (see ref. [3]) or electrical (see ref. [4]). From the point of view of the kinematics, they represent special cases of those considered in our account.

## 2. Main Mathematical Relations of Drawing

**Let** us consider (see figure 1) a drawing sequence of a wire having an initial diameter $d_o$ through n dies, the successive diameters of which are:

$d_1, d_2, d_3 \ldots\ldots\ldots d_i \ldots\ldots\ldots d_n$,

where $d_i$ is any diameter.

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**For** our general considerations, we do not make for the moment any assumption regarding the mode of application of the forces acting on the wire between the various dies. We shall further on come back to this problem at the time of examining the various types of wire-drawing machines.

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**Let** us again assume that the initial length $l_0$ of the wire successively becomes after the drawing:

$l_1, l_2, l_3 \ldots\ldots\ldots l_i, \ldots\ldots\ldots l_n$

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**The** main mathematical relation of the drawing is the constancy condition of the wire volume, viz.:

$$d_o^2\, l_o = d_1^2\, l_1 = d_2^2\, l_2 = \ldots\ldots d_i^2\, l_i = \ldots\ldots d_n^2\, l_n \quad (1)$$

(x) The figures in brackets relate to the bibliography at the end of the work.

By dividing all the terms of this expression by $d^2_n \; l_n$ and writing in general terms, it is obtained:

$$\left( \frac{d_1}{d_n} \right)^2 \cdot \frac{l_1}{l_n} = 1 \quad (2)$$

or under logarithmic form

$$\lg \frac{l_1}{l_n} = - \lg \left( \frac{d_1}{d_n} \right)^2 \quad (2a)$$

Let us again introduce the notions of relative reduction of area $\left[\frac{\Delta s_{ik}}{s_i}\right]$ and relative elongation $\left[\frac{\Delta l_{ik}}{l_i}\right]$ between any two dies i and k, viz.

$$\frac{\Delta s_{ik}}{s_i} = \frac{d_i^2 - d_k^2}{d_i^2} = 1 - \frac{d_k^2}{d_i^2} \quad (3)$$

and

$$\frac{\Delta l_{ik}}{l_i} = \frac{l_k - l_i}{l_i} = \frac{l_k}{l_i} - 1 \quad (3a)$$

where $\Delta s_{ik}$ and $\Delta l_{ik}$ mean the absolute reduction of area and elongation whereas $s_i$ and $l_i$ are the absolute values of the area and of the length at the stage i, this last value being already defined above.

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By introducing (3) and (3a) in 2 and replacing the index n by k, it is obtained:

$$\left( 1 + \frac{\Delta l_{ik}}{l_i} \right) \left( 1 - \frac{\Delta s_{ik}}{s_i} \right) = 1 \quad (4)$$

expression which is only another form of (2) and which may also be written under logarithmic form:

$$\lg \left( 1 + \frac{\Delta l_{ik}}{l_i} \right) = - \lg \left( 1 - \frac{\Delta s_{ik}}{s_i} \right) \quad (4a)$$

In the case of a slip type multiple wire-drawing machine, the lengths $l_0 \ldots\ldots l_i \ldots\ldots l_n$ may be replaced in the previous calculation by the effective speeds of the drawn wire:

$v_0, v_1, v_2 \ldots\ldots\ldots v_i \ldots\ldots\ldots v_n$

the lengths $l_0 \ldots . l_i \ldots . l_n$ having to pass through the dies in the same lapse of time. It is thus obtained from the expressions (2) and (2a):

$$\frac{v_1}{v_n} \left( \frac{d_1}{d_n} \right)^2 = 1 \quad (5)$$

viz.

$$\lg \frac{v_1}{v_n} = - \lg \left( \frac{d_1}{d_n} \right)^2 \quad (5a)$$

It is known that in the slip type wire-drawing machines, the circumferential speeds of the drawing capstans have to be greater by some per cent than the speeds of the wire at the corresponding stages. Only the speed of the finishing block preceding the take-up reel is equal to that of the wire. By adopting the notations:

$v'_1, v'_2 \ldots . v'_i \ldots . v'_n = v_n$

for the circumferential speeds of the drawing capstans and:

$a_1, a_2, \ldots\ldots a_i \ldots\ldots a_n$

for the factors indicating how many times the circumferential speeds of the drawing capstans are greater than those of the wire (a>1), it is obtained from the expression (5):

$$\frac{1}{a_1} \frac{v'_1}{v_n} \left( \frac{d_1}{d_n} \right)^2 = 1 \quad (6)$$

viz.

$$\lg \frac{v'_1}{v_n} - \lg a_1 = - \lg \left( \frac{d_1}{d_n} \right)^2 \quad (6a)$$

Let us now consider a classical wire-drawing machine with storage of the wire at each drawing stage. The circumferential speeds of the drawing capstans and of the drawn wire are equal but, on the other hand, the speed with which the wire enters any die is lower than that with which it goes out of the preceding die, whence comes the accumulating of the wire at each stage. With a view to satisfy the relations of the volume constancies (1), (2) and (5), the factors $b_1, b_2, \ldots\ldots b_i \ldots\ldots b_n$ expressing the ratios between the circumferential speeds of the drawing capstans ($v'_i$) and the theoretic speeds of the wire according to the expression (5) have to be introduced. It is thus obtained:

$$\frac{1}{b_1} \frac{v'_1}{v_n} \left( \frac{d_1}{d_n} \right)^2 = 1 \quad (7)$$

viz.

$$\lg \frac{v'_1}{v_n} - \lg b_1 = - \lg \left( \frac{d_1}{d_n} \right)^2 \quad (7a)$$

The factors $b_1 \ldots\ldots b_n$ also express the ratios between the volumes of wire passing through the various stages and the volume delivered at the same time by the wire-drawing machine $(b > 1)$, what follows at once from (5).

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The choice of $d_n$ and $v_n$ as reference values in the above developed equations is justified by the fact that $v_n$ is the only wire speed which does not vary if the diameters of the dies are changed, for it is equal to the speed of the finishing block before the take-up reel on condition, of course, that the gears determining this speed are not altered.

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We assume that the reader is sufficiently familiar with the construction principles of both types of above mentioned wire-drawing machines to make unnecessary more detailed explanation on this point.

## 3. Graphic Representation of the Working Conditions of a Slip Type Multiple Wire-Drawing Machine

### a) Representation of the Speeds and Elongations in Terms of the Areas and Reductions of Area

As regards the mechanical phenomena which occur outside the dies, the working conditions of a slip type multiple wire-drawing machine are entirely characterized

lg=means logarithm of any base and ln=natural logarithm.

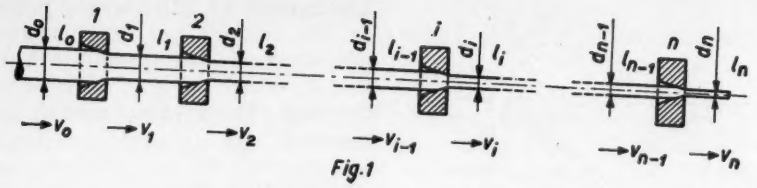


Fig. 1. Sequence of the diameters, the lengths and the speeds of the drawn wire. * * *

by the expressions (4), (5) and (6). In order to simplify the graphic representation of these equations, they have been represented in logarithmic form and the expressions (4a), (5a) and (6a) have been obtained. Indeed, the formulas (4a) and (5a) are represented in logarithmic co-ordinates by one same bisecting straight line of the co-ordinate axes inclined to 45° with regard to the latter. (See straight line o, ol-1 on Fig. 2.)

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By taking into account the negative sign of the second member of the expressions (4a), (5a) and (6a), the abscissas $\left[\frac{d_i}{d_n}\right]^2$ and $\frac{d_i}{d_n}$ have decreasing values from left to right for increasing values of $\frac{v_i}{v_n}$. With a view to facilitate the reading, the co-ordinates

$$1 - \frac{\Delta s_{in}}{s_i} \text{ and } 1 + \frac{\Delta l_{in}}{l_i}$$

are dimensioned in per cent

$$\left[\frac{\Delta s_{in}}{s_i} 100 \text{ and } \frac{\Delta l_{in}}{l_i} 100\right]$$

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As to the expression (6a), it can be shown by a sequence of points situated above the axis bisectrix, which represents the speeds of the wire according to the expression (5a). Indeed, the speeds of the drawing capstans of the slip type wire-drawing machines are always slightly greater than those of the wire. The representation of the expression (6a) in logarithmic co-ordinates enables us to determine or at least to estimate with a sufficient accuracy the differences between the speeds of the drawing capstans and those of the wire, in per cent of the speeds of the wire. With this object, it has been drawn in the figure 2, parallelly to the axis bisectrix, the straight lines relating to the equations $a_i = \text{constant}$ and they have been dimensioned in per cent according to the expression:

$$a_1 - 1 = p_1 = \text{constant} \quad (8)$$

where $p_1$ is the slip percentage of the capstans with regard to the wire. Charts like figure 2 may be prepared in advance; they are suitable to the wire-drawing machines with 14 - 16 stages.

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A practical example will enable us to better fix the ideas. Let us consider a slip type multiple wire-drawing machine intended to draw the copper wire in 13 stages. With a view to be in a position to get a nearer concept of the working conditions of this machine, we intend drawing its diagram in compliance with the expressions (4a) and (6a). Let us at first calculate the 12 relative circumferential speeds $v_1'/v_n$ of the drawing capstans according to the diagram of the gears and the diameters of the capstans and then the 13 ratios $d_i/d_n$ of the diameters of the dies including the initial diameter of the wire $d_o$, together with the squares of these ratios $\left[\frac{d_i}{d_n}\right]^2$. By drawing then on the diagram of figure 2 the values $v_1'/v_n$ in terms of $\left[\frac{d_i}{d_n}\right]^2$, one obtains (see figure 3) 12 points (1′ to 12′), which correspond to the circumferential speeds of the drawing capstans and 13 points (0 to 12) situated on the straight line inclined at 45° and relating to the speeds of the wire. The point 13, the co-ordinates of which are $\left[\frac{d_i}{d_n}\right]^2 = 1$ and $\frac{v_i}{v_n} = 1$ corresponds to the wire

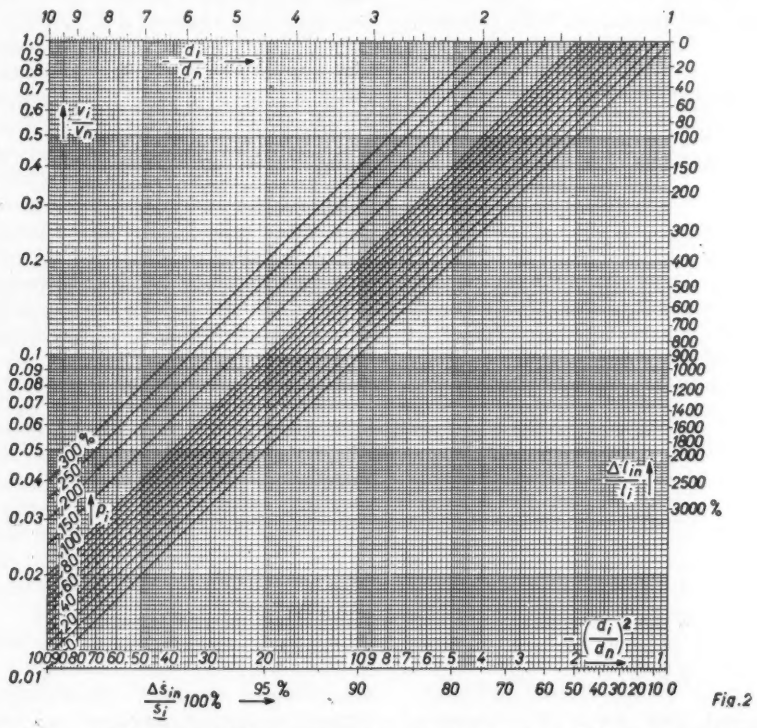


Fig. 2. Chart of the relative speeds and the relative diameters of the dies in logarithmic co-ordinates used for the working diagram of the drawing machines. * * *

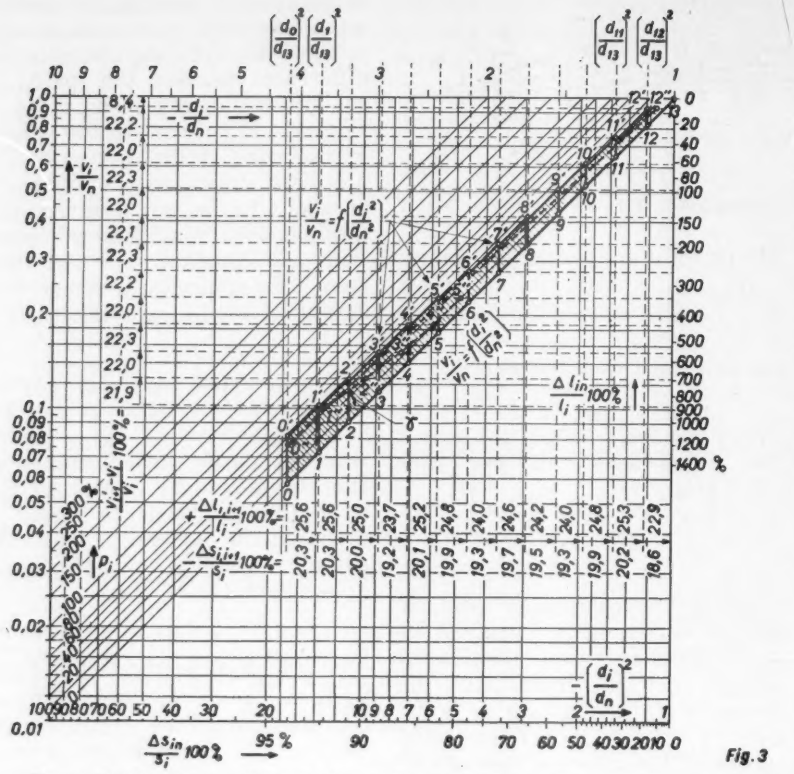

Fig. 3. Working diagram of the slip type continuous drawing machine.

going out of the machine. The points 1'-12' are situated above the points 1-12, the speeds of the capstans being greater than those of the wire and the vertical distance between corresponding points, for instance, between 3' and 3 is equal, from the expressions (6) and (8), to $a_i$ or $p_i$ according to the scale in which the distance has been measured. The diagram of figure 3 also enables us to determine the elongations and reductions of area of the wire between any two dies by measuring, according to the expression (4) with the scales $\frac{\Delta l_{in}}{l_i}$ and $\frac{\Delta S_{in}}{S_i}$, the horizontal and vertical distances (which are equal) between the points situated on the straight line inclined at 45° and corresponding to the dies in question. As an example, it has been noted in per cent in figure 3, at each stage and with regard to the previous stage, all the elongations and reductions of area of the wire together with the increases of the circumferential speeds of the drawing capstans $\frac{v_{i+1}-v'_i}{v_i}100\%$, which are measured with the same scale as the elongation.

## b) Graphic Representation of the Energy Losses Due to Friction Between the Drawing Capstans and the Wire

Let us consider a drawing capstan of the stage i situated between the dies numbered i and i + 1 (see figure 4). The force required for drawing the wire through the die i is $F_i$, whereas that acting on the part of the wire going out of the capstan is:

$$F'_i = \frac{F_i}{e^{\mu_i \omega_i}} \quad (9)$$

where e is the base of the natural logarithm, $\mu_i$ is the coefficient of friction often estimated at 0.05 ... 0.10 (see [1] and [5]) and $w_i$ angle of contingence of the wire on the capstan. If we do not take into account the force $F'_{i-1}$ required for ensuring the wire tension on the capstan i–1, the drawing power at the stage i can be calculated according to the formula: $P_i = F_i : V_i$ where $v_i$ is the speed of the wire. The greatest part of the power $P_i$, viz.

$$P'_i = (F_i - F'_i)\, v_i = F_i \left(1 - \frac{1}{e^{\mu_i \omega_i}}\right) v_i \quad (10)$$

is supplied by the capstan i and the remainder $\frac{F_i v_i}{e^{\mu_i \omega_i}}$ by the capstan of the following stage through the die i+1. The power $P_{fi}$ of the losses due to the friction of the wire on the capstan i is calculated in the same manner:

$$P_{fi} = (F_i - F'_i)(v'_i - v_i) = F_i \left(1 - \frac{1}{e^{\mu_i \omega_i}}\right)(v'_i - v_i) \quad (11)$$

$v'_i$ being, as in the preceding paragraph, the circumferential speed of the capstan. By dividing (11) by (10), it is obtained:

$$\frac{P_{fi}}{P'_i} = \frac{v'_i - v_i}{v_i} = a_i - 1 = p_i \quad (12)$$

where $p_i$ is the rate of the energy losses due to friction between the wire and the capstan with regard to the work usefully supplied by the capstan, whereas $a_i$ has already been defined by the expression (6). On the other hand, as we are already aware, $p_i$ is equal to the slip percentage defined by the expression (8) and can be found directly on the diagram (figure 2) representing the expression (6a).

* * *

**Moreover,** it is easy to prove that the absolute value of the energy losses $P_{fi}$ due to friction of the wire on the drawing capstan i can be represented by the surface of the parallelogram situated between the straight line of the relative speeds of the wire $\frac{v_i}{v_n}$ and the piece of straight line which is drawn under an angle of 45° as the first one and included between

the point representing the relative speed $\frac{v_i}{v_n}$ of the drawing capstan in question (i') and the vertical passing through the point corresponding to the previous capstan (i-l)'. This surface is delimited on the other hand by two verticals passing through the points i' and (i-l)' (see figure 3).

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**For** the demonstration, we may take as a basis the expression of the drawing tension developed by **E. Siebel** and his collaborators (see [6], [7] and [8]) without taking into account the small "redundant work" (see[1]). It is interesting to ascertain that for the drawing work, practically the same expression has been lately developed by **R. Hill and S. J. Tupper** [9] by taking as a basis the considerations different from those of their predecessors. The common expression of the quoted authors may be written in the following form:

$$F_1 = s_1 Y_m \left(1 + \mu_i' \operatorname{ctg} \alpha_i\right) \ln \frac{s_{i-1}}{s_1} \quad (13)$$

where $Y_m$ is the mean yield stress and may be assimilated, in the practical calculation, to the mean value of the tensile strength before and after the drawing. Let us also note that $\mu_i'$ means the coefficient of friction between the wire and the die and $\alpha_i$, the half-angle of the die. If for any reason, it is preferred to use another expression for the drawing work, for instance, that well-known of G. Sachs [10], the same final result is attained provided some mathematical simplifications are made, but with a reasonable approximation.

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**By** introducing (13) in (11), it is finally obtained for the power lost by friction on the capstan:

$$P_{f1} = V_o Y_m f\left(\mu_i, \mu_i', \omega_i, \alpha_i\right) p_1 \ln \frac{s_{i-1}}{s_1} \quad (14)$$

expression where $V_o$ is the drawn volume during the unit of time and $f(\mu_i, \mu_i', \omega_i, \alpha_i)$ a constant dependent on the parameters in parentheses. Since the horizontal distance between the points i and (i - l) (see figure 3) is proportional to $\ln \frac{s_{i-1}}{s_i}$ and the vertical distance between the points i and i' is proportional to $p_i$, our affirmation is proved. In an exact calculation of course, the distance $p_i$ has to be measured in logarithmic scale. For the practical calculation, however, as in general $p_i \ll 1$, the vertical sides of the parallelogram of losses, equal to $\lg_a A_i = \lg_a (1 + p_i) \simeq \frac{p_i^*}{\ln a}$ may be measured in linear scale. Thus the value in square millimeters of the hachured parallelograms surface on the figure 3 limited by the verticals i, i' and (i-l), (i-l)' (for example 3,3' and 2,2') may be considered with a good approximation as proportional to the energy losses due to friction of the wire on the capstan 1.

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**Coming** back to our example, it is found in figure 3 that the rate of slip and the losses due to friction are about 13% with the capstan N° 12, about 42% for the capstan N° 1 and approximately 24.5% as mean value for the whole machine. The chosen example is an extreme case in order to better show up the ratios between the various factors characterizing the work of the wire-drawing machine; but it however refers to an experiment with a real machine for which the measurements made have confirmed that it was overloaded.

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**The** diagram of figure 3 also shows us the means of decreasing the losses due to friction on the capstans, while maintaining the same total reduction of the wire area viz.: by the suitable choice of the set of dies. Indeed, by choosing the dies according to the broken line 0", 1", 2", 3" etc. . . . , a considerable reduction of the initial surface of the losses (hachured surface of figure 3) is obtained. The value of this reduction of the losses due to friction is chiefly limited by the elongation increase of the wire in the first dies; in our example, we have fixed this elongation at 35% for the die N° 1.

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**In** the cases where the losses due to slip on the first capstans are less heavy than in our example, the points corresponding to the intermediate dies along the straight line 1" - 12", represented in figure 3, in interrupted dashes may be chosen. The elongation at the first stage is chosen for the greatest possible value, according to the metal to be drawn and the particularities of the machine. The rate of slip on the last but one capstan (N° 12 in our example) is then fixed at the lowest permissible value, for instance 4 to 5% and the diameters of the intermediate dies are found on the line 1" - 12". As it will be seen farther on, in the case of our example, it so succeeded in reducing the losses due to slip from 24.5% to about 17%.

### c) Generalization of the Considerations About the Slip Type Wire-Drawing Machines

**By** designating by $\delta$ the angle made with the horizontal axis of the co-ordinates by the straight line connecting two neighbouring points representing the circumferential speeds of the drawing capstans, for instance i' and (i+l)', it is obtained at once in the figure 3:

$$\lg\left(1 + \frac{\Delta l_{i,i+1}}{l_1}\right) = -\lg\left(1 - \frac{\Delta s_{i,i+1}}{s_1}\right) = \operatorname{ctg}\delta \lg\left(1 + \frac{\Delta v'_{i,i+1}}{v'_i}\right) \quad (15)$$

or also, since $\frac{\Delta l_{i,i+1}}{l_1} \ll 1$, $\frac{\Delta s_{i,i+1}}{s_1} \ll 1$ and that $\frac{\Delta v'_{i,i+1}}{v'_i} \ll 1$

*) a-means the base of logarithm.

$$\frac{\Delta l_{i,i+1}}{l_i} \simeq \frac{\Delta v'_{i,i+1}}{v'_i} \cdot \operatorname{ctg}\gamma \simeq \frac{\Delta s_{i,i+1}}{s_i} \quad (15a)$$

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**Considering** that the relative difference of the circumferential speeds of two neighbouring capstans $\frac{\Delta v'_{i,i+1}}{v'_i}$ is in general nearly constant for a given machine, ctg $\gamma$ may be considered as the measure or the index of elongation or reduction of the area in the stage in question. The expression (15) may also be applied for the drawing between any two dies i and k, for instance between the first die N° 1 and the last one n; in this case, it is obtained, if the angle $\gamma$ is not constant for all the stages, an angle $\gamma_m$ which is the index of the mean elongation of the machine.

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**The** angle $\gamma = 45°$ corresponds in the expression (15) to an elongation of the wire equal to the increase of the circumferential speeds of the drawing capstans, which is the smallest elongation that can theoretically be realized with a given machine; but on the other hand, the drawing would occur in this case without loss due to slip. To the minimum theoretic elongation or to the minimum reduction of area, the elongation or the reduction of area at the first stage is also to be added, these factors being variable within the limits fixed in the first place by the properties of the drawn metal. It is thus obtained for a given machine the minimum reduction of the areas:

$$\left(\frac{s_o}{s_n}\right)_{min} = \frac{v_n}{v'_1} \cdot \frac{s_o}{s_1} \quad (16)$$

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**Should** we wish to increase in a machine the total reduction of the areas beyond the value given by the expression (16), the ctg $\gamma$ has to be increased and consequently the factors of slip $p_i$. A very simple expression may be deducted from (6) and (8):

$$p_1 = \frac{v'_1}{v_n} \cdot \frac{s_1}{s_n} - 1 = \frac{v'_1}{v_n} \cdot \frac{l_n}{l_1} - 1 \quad (17)$$

which gives us the rate of local slip in terms of either the reduction of area $\frac{s_1}{s_n}$ or the desired elongation $\frac{l_n}{l_1}$.

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**The** expression (17) shows us the positive and useful part of the rate of slip, namely as a means to increase the total reduction of the drawn wire area, whereas the expression (14) indicated to us its negative part as a responsible factor of the losses due to slip.

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A reasonable compromise is imperative in the choice of the working conditions and a diagram like figure 3 will always enable us to find the set of dies ensuring the reasonable minimum of losses due to slip.

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As we have already mentioned above, in the event of $p_i$ given by 17 being not too great, we may arbitrarily fix the value of $p_{n-1}$, e.g., to 4 to 5% for the last but one stage and choose the intermediate dies along the straight line connecting the points 1′ and (n-1)′ of our diagram (for instance line 1″ to 12″ in figure 3) without the losses due to slip being too different from those ensured by a broken line such as 1″, 2″, 3″; . . . By way of compensation, the arrangement of the dies along the straight line enables us to calculate at once the mean value of p and consequently the total rate of the losses according to the expression:

$$p_m = \frac{n-1}{2n}\left(p_1 + p_{n-1}\right) \quad (18)$$

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**The** expression (18) is based on the hypothesis that the drawing powers at each stage are nearly equal, which, according to (13), may be admitted with a sufficient approximation for practice.

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By adapting the expression (18) to our example, the percentage of the losses due to slip can be calculated for the set of dies which is chosen along the line 1″ - 12″ in figure 3 and it is obtained:

$$p_m = \frac{12}{2.13}\left(0{,}32 + 0{,}05\right) = 0{,}171 \quad (18.a)$$

which represents the appreciable gain of 7.4% with regard to the initial losses (24.5%). Let us also note that by choosing the intermediate dies according to the broken line 1″, 2″, 3″ . . . , it is seen that $p_m \simeq 10.5\%$.

## 4. Graphic Representation of the Work of a Multiple Wire-Drawing Machine with Storage of the Wire

**The** diagram of the speeds of a multiple wire-drawing machine with storage of the wire does not greatly differ from the one of a slip type wire-drawing machine. As, in this kind of machine, the drawing is made without slip, the points representing the circumferential speeds of the drawing capstans and the speeds of the wire passing on the capstans are common (see points 1′-11′ in figure 5). The wire leaving any drawing capstan goes into the following die with a lower speed than that with which it has passed on this capstan. On our diagram, we have therefore on a vertical corresponding to each drawing stage, two distinct points representing the two in-and-outgoing speeds of the wire (see points 1′, 1″ etc. in figure 5). The distance between these two points represents the differences of the speeds of the wire and may be considered as an index or rate of storage of the wire on the drawing capstans and its numerical value can be found in per cent on the scale $p_i$.

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It should also be stated that the points representing the in-and-outgoing speeds of the wire of the same die and belonging therefore to two neighboring diameters, have to be situated according to the expression (5) on the same straight line inclined at 45° with regard to the co-ordinate axis (see points 1″ - 2′, 2″ - 3′ etc. . . . in figure 5).

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**Finally** the points 1 . . . 12 situated on the straight line inclined at 45° passing through the point 12 (wire going out of the ma-

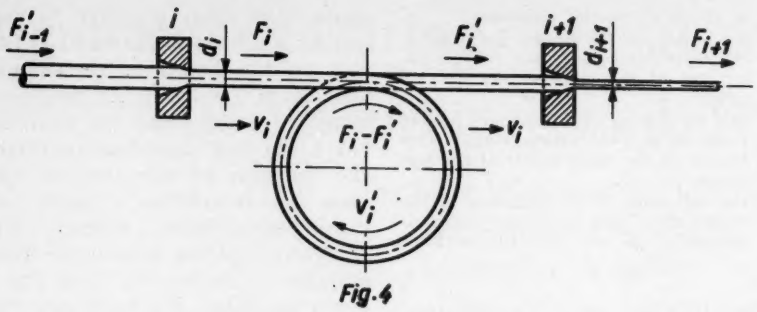


Fig. 4. Drawing forces between two dies.

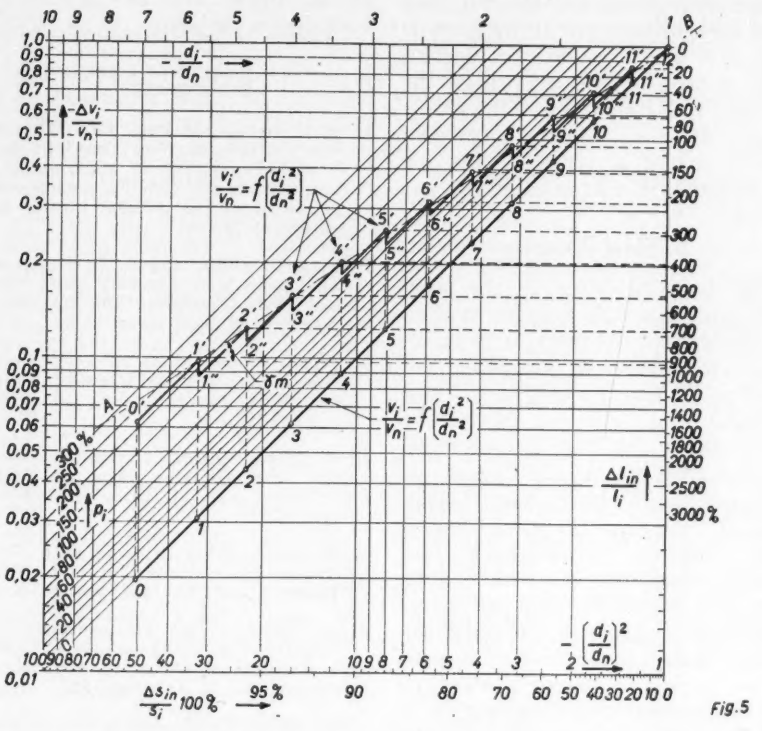


Fig. 5. Working diagram of the non-slip continuous drawing machine.

chine) represent the theoretic drawing according to the expression (5).

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**Figure** 5 represents the diagram of the work of a multiple wire-drawing machine with storage of the wire, intended for drawing the copper wire in 12 stages. As in the previous example, for drawing up the diagram, it is sufficient to calculate the 11 relative speeds of the drawing capstans $\frac{v'_1}{v_n}$ and the 12 relative diameters of the dies $\frac{d_1}{d_n}$ including the initial diameter $d_o$ of the wire to be drawn. It is then necessary to draw the diagram of the speeds $\frac{v'_1}{v_n}$ in terms of $\left[\frac{d_1}{d_n}\right]^2$ (points 1′ . . . 11′) and complete it by portions of straight lines according to the previous considerations. The points 1″-12″ corresponding to the speeds of the wire going out of the drawing capstans are automatically obtained without previous calculation.

All the points 1′-11′ are located in figure 5 above the straight line inclined at 45° corresponding to the theoretic drawing (points 1-12). The vertical distances between the points 1′-11′ and the straight line 1-12 represent, according to the expression (7), the ratios of the speeds $b_1 = \frac{v'_1}{v_1}$ or the ratios of the volumes of effectively drawn wire at the various stages per unit of time to the volume of the wire going out of the machine during the same lapse of time.

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**The** volume excess of the drawn wire at the various stages can be measured in per cent with a scale $p_1$ identical with that of the previous case ($p_1 = b_1 - 1$).

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**The** presence of a surplus of drawn volume per unit of time at the various stages has as a consequence that the instantaneous powers of these stages are also greater than their mean powers or the mean power of the last stage. These mean powers are nearly equal if the reductions of the areas at the various stages are more or less the same. By taking as a basis the considerations of the paragraph 3b, the difference between the instantaneous power of any stage $P_1$ and its mean power $P_m$ required for drawing the volume delivered by the last stage may be expressed by a formula analogous to the expression (14), namely:

$$P_1 - P_m = V_o \gamma_m \left(1 + \mu'_i \operatorname{ctg} \alpha_i\right) p_1 \ln \frac{s_{1-1}}{s_1} \quad (19)$$

where $V_o$ is the volume of the wire going out of the machine per unit of time. From this expression, it follows that the surplus of the instantaneous power of the various stages may be represented by the surface of the parallelogram i, i-1, (i-1)″, i′, (e.g.: 4,3,3″, 4′) as it was in the case of losses due to friction of the wire on the drawing capstans in a slip type machine.

The expressions (15), (15a), (16) and (17) which are developed in the preceding paragraph for the slip type wire-drawing machines are also valid for the machines with storage. It follows from (15) that the straight line connecting any two points representing the circumferential speeds of the drawing capstans makes with the horizontal axis an angle $\gamma$ the cotangent of which may be considered as the measure of the mean elongation or the mean reduction of area between the points in question (see figure 5).

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The expression (16), as in the preceding case, gives the theoretic minimum of the total reduction of area for which $\gamma$ is equal to 45° whereas, according to (19), the increase of the instantaneous power disappears. Any increase of the

$$\text{total elongation } \frac{l_n}{l_o}$$

or of the total reduction of the area

$$\frac{S_o}{S_n}$$

beyond the value of the expression (16) will be accompanied not only by an increase of the mean drawing power in terms of

$$\ln\frac{S_{i-1}}{S_i}$$

(see the expression 13) but also by an increase of the instantaneous power according to (19). By increasing

$$\frac{S_1}{S_n}$$

beyond the expression (16), we will of course reduce the angle $\delta$ and consequently increase the rates of storage, which will provoke the quicker filling of the drawing blocks and require more attention and handling from the machine-minder.

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In short, the diagram of figure 5 gives us the following information:

a) the elongations and reductions of area of the wire at each stage of the machine,

b) the rates of storage or the differences of the in- and-outgoing speeds of the wire on the capstans,

c) the ratios of the drawn volumes at the various stages to the volume going out of the machine per unit of time,

d) the surplus of instantaneous power required at the various stages with regard to the mean power of the last stage,

e) the indication of the influence of the chosen set of dies on the working conditions of the wire-drawing machine.

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For this last point, the obtained indications for a wire-drawing machine with storage of the wire are less categorical than in the preceding case for no additional energy loss occurs, at the very least directly. A distribution of the diameters of the intermediate dies nearly along a straight line, as in figure 5, is always correct.

## 5. Final Remarks

We have explained in the present paper a simple graphic method of analysis of the work of the multiple wire-drawing machines enabling to find quickly a correct answer to the greatest part of the problems which may be set to us by the practice. At the foot of our diagrams, we have also briefly stated some general properties of the multiple wire-drawing machines which are certainly known by the manufacturers of wire-drawing machines and cautious wire-drawers, eventually in another form. In taking the liberty of dealing with this subject, it is to demonstrate the merits and the efficiency of our analysis method.

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The most important application of our graphic method seems to us to be the rational choice of the sequence of drawing dies, which is a problem of great importance, principally for the slip type machines, that are often treated too schematically, without taking into account the particularities of the machine in question. An increase of machine efficiency, a decrease of wear on the drawing capstans and a reduction of the copper powder formation in the drawing bath have been observed by suitably applying the method explained.

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We should like to emphasize again that this method is not merely a calculation method of the sets of dies based on an elongation or a reduction of area assumed a priori (see for example [11]). As has been demonstrated, the purpose of our method has been to determine a basis for these calculations, namely, the elongations of the wire or the most suitable reductions of area for a given machine. We hope that our account will be found to be useful by all those who are concerned with these problems.

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Note: This paper was supplied to Wire and Wire Products in June, 1954.

# Accurate Measuring of Insulated and Bare Wire Its Importance and Techniques

by Alden W. Nelson, Chief Engineer
Davis-Standard Sales Corp.
Mystic, Connecticut

**Measuring errors should not exceed 1/10th of 1 percent, the author states, and in this article he describes how accurate linear measurements can be obtained.**

## How Important is Accuracy?

**In** the average wire mill, the wire measuring machine does a job that is vastly more important than the relative simplicity of the machine would indicate.

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**If** a customer orders 1000 feet of wire from you, he will not be pleased to receive 990 feet. And if you send him 1010 feet he will not thank you for the surplus. It is ethically (to say nothing of legally) wrong to furnish less than was paid for. And it is economically unsound to supply a "baker's dozen" when only twelve are expected. The problem, then, is to supply at least as much as is ordered, and as little more as possible. And the amount of wire you give away, reel after reel, to stay on the safe side, is inversely related to the amount of faith you have in your measuring machine. The greater the faith, the better your position in a highly competitive industry.

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**As** a simple check on your machine, chalk off a 100-foot length with a steel tape on the floor. Use this length to measure 1000 feet of wire, and compare that with what your measuring machine tells you is 1000 feet. A good machine should be accurate within 0.1 percent, or less than one foot in 1000. If a machine is less accurate than this it can, of course, be calibrated to compensate for the error. But with a number of machines, all with different corrections, operated by two or three shifts, the calibration factors can easily become confusion factors. A better solution would be to obtain a machine that is accurate and dependable.

## Techniques for Accurate Measurement of Insulated Wire

**Most** wire measuring machines include a measuring wheel that is friction-driven by the wire passing through the machine. Thus linear motion of the wire is translated to the rotary motion of the wheel, and a counter records the number of turns made by the wheel. The wire is usually held against the measuring wheel by a second (pressure) wheel. In this system, accuracy is improved by:

1. **Having the wire contact the measuring wheel only tangentially.**
2. **Holding the pressure of the wheel on the wire to somewhat near the minimum that will prevent slipping.**
3. **Using a measuring wheel of large diameter.**
4. **Holding inertia and friction in the moving parts to a minimum.**
5. **Reducing wear of the wheel rim to a minimum.**
6. **Using an accurate counter.**

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**The** wire should contact the wheel only tangentially. Contact over even a small arc on the wheel surface introduces an error, since the wheel then measures along the compressed insulation on the inside of the bend. Consider an extreme case in which the wire makes one complete turn around the wheel. Let the wheel diameter be D and the wire diameter d. For each revolution of the wheel, the counter should record a passage of $\pi D$ inches of wire. Actually an amount $\pi(D + d)$ (measured along the centerline of the wire) has passed through. So, each time the wheel turns, it gives away $\pi d$ inches of wire.

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**Pressure** of the wheel on the wire is a very important variable. If it is too low, slipping will occur, the counter will not record all the wire passing through, and again the measuring machine is giving away wire.

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**Since** too high a wheel pressure causes the machine to record a greater than actual length, this condition is even more serious. Giving more than the customer buys may only put you out of business, but giving less may put you in the ungentle hands of the law.

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**If** the wheel pressure is too high, the excessive indentation made in the insulation surface causes the wheel to measure along the arc of stretched insulation and to record too high a measurement. This is shown in figure 1. For an angular displacement A of the measuring wheel, a length S (along the arc) is recorded by the counter, although only a length of wire L (along the chord) has passed through the machine. This error decreases with harder insulations, but it is always present to some degree when measuring insulated wire. Most measuring machines, because of wheel weight or spring loading, tend to err on the side of too much, rather than too little wheel pressure.

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**Because** of the error caused by deforming the insulation, accuracy improves with increasing wheel

diameter, since the dent caused by a larger wheel forms a flatter arc. However, a compromise is necessary here, since a heavier wheel, because of its inertia, increases the likelihood of slipping when the wire accelerates. The region of happy compromise seems to be in the neighborhood of an 18-inch circumference.

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**If,** instead of gearing one wheel to the counter and allowing the other to idle, both wheels are geared to the counter, the pressure of wheel on wire can be decreased, and thus a more accurate count obtained. However, the line connecting the wheel centers should remain perpendicular to the wire path, even though the wire diameter changes. This means that the wheels should be mounted in such a way that they move equal distances when opening up for a larger wire diameter. If they do not, the wire will contact them not tangentially, but along a small arc.

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**The** measuring wheel should have low rotary inertia to minimize the chance of slipping when the wire accelerates or decelerates. A material of low density, such as aluminum, and a design featuring minimum weight consistent with strength requirements, are the solution.

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**Since** a low wheel contact pressure has been shown to be desirable, it follows that all moving parts, including the counter, should be as free-running as possible. It would be a mistake to take all the pains described thus far, and then fail to provide good precision ball bearings for all rotating parts. It would also be a mistake to pump grease into these bearings, since this would increase the drag in the system, especially at high speeds.

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**Aluminum** has been mentioned as a desirable material for the wheel. There is, however, the question of wear. As the wheel rim wears down, the machine begins to indicate a footage that is too high, to the customer's disadvantage. For each 0.001 inch of wear on the rim of an 18-inch circumference wheel, this error amounts to more than one-third foot per 1000 feet.

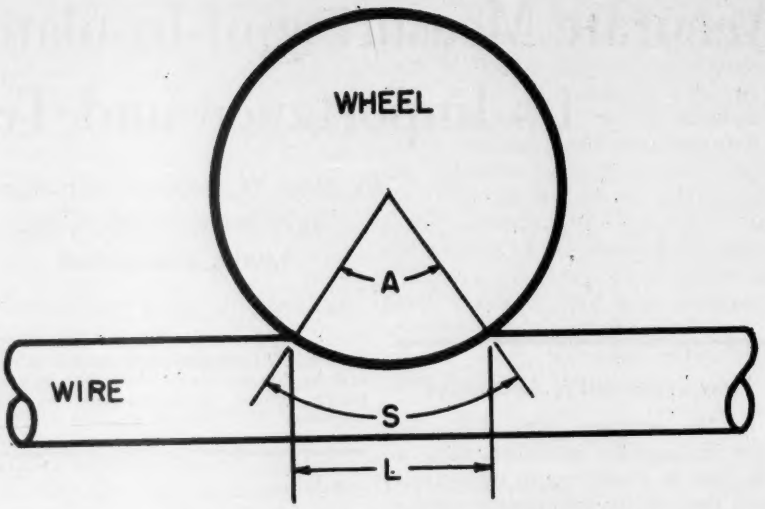


Figure 1—Error Caused by Indentation of Insulation. * * * * * * * * * *

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A way has been found to bond a hardened steel spray securely onto the rim of an aluminum wheel. Besides resisting wear, this provides an excellent frictional surface for driving the measuring wheel by insulated wires.

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**Where** necessary, a brake should be provided to stop the wheel in the event the end of the wire runs out, since the resulting contact between the wheels would cause undue wear.

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A wire measuring machine is no better than its counter. There are a number of reliable counters on the market. Most applications require a totalizing counter which records production over a day, a week, or a longer time period. This counter is usually provided with a wing nut, or is reset by a key, usually in the custody of Production Control. For winding reel or coil lengths an additional counter may be used having a lever reset for the convenience of the operator.

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**Electric** predetermining counters may be used to provide a signal to the operator or to stop the wire take-up automatically. One measuring machine now on the market uses two electric predetermining counters for this job. In high speed coiling of, say, a 500-foot length, the wire movement is rapid until the first counter is tripped at a setting of about 490 feet. The coiler and pay-off are braked to a stop, and restarted immediately at a slower speed. When the second counter trips at 500 feet, the final braking is instantaneous with no overtravel. Both counters are then automatically reset to zero for the next coil.

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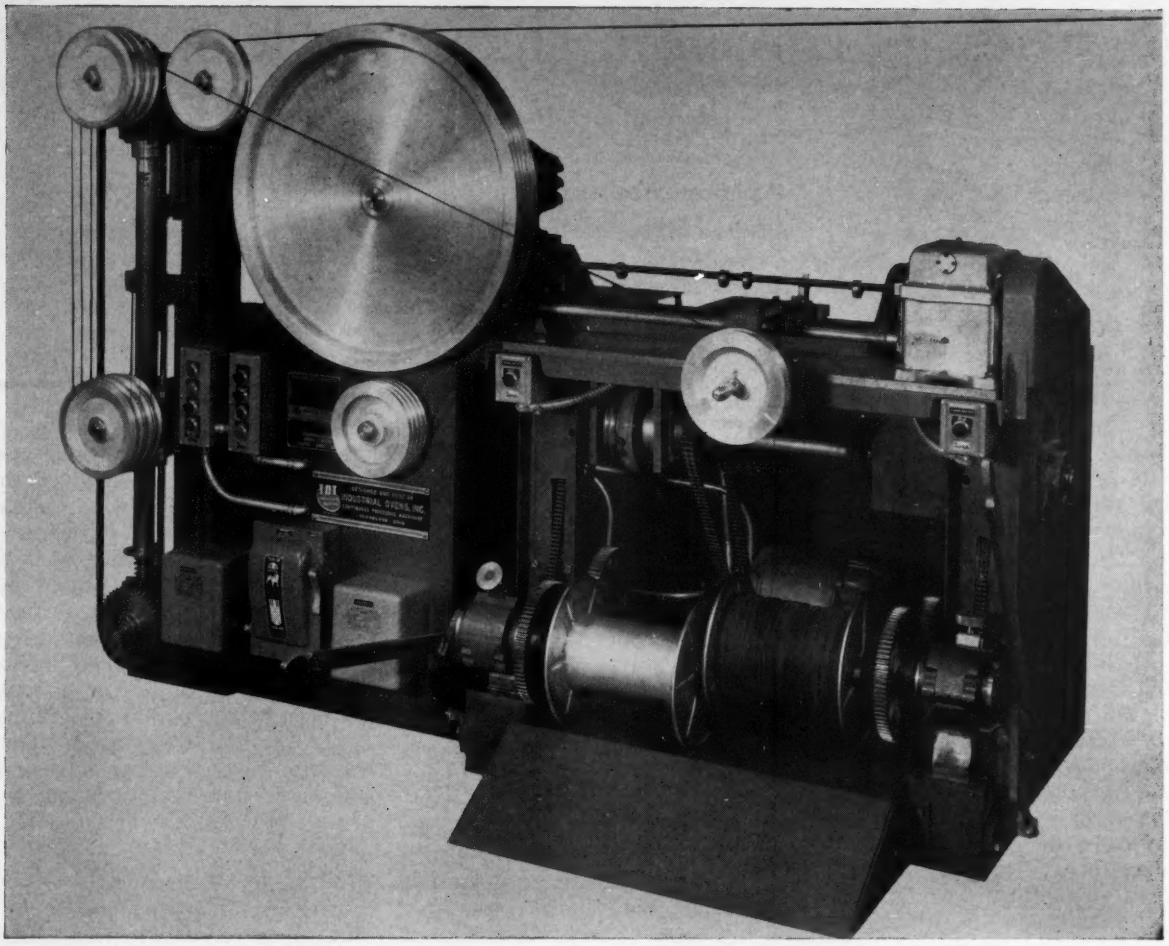
**Perhaps** the most important application of the measuring machine is in the fully automatic operation of a dual reel take-up used with continuous wire movement in a plastic extruding or continuous vulcanizing line. For this type of operation, Davis-Standard provides a single, electric predetermining counter in its dual-wheel measuring machine. This counter is probably unique in that it automatically resets to zero without requiring an external reset, either mechanical or electrical. The highly desirable feature of this type of counter is that, regardless of the wire speed at the time of reset to zero, not a single foot of wire measurement is lost. The importance of this is illustrated

(*Please turn to page* 349)



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# Stress Corrosion in High Tensile Wire

by Walter O. Everling
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Cleveland, Ohio

**In this paper, published through the courtesy of the author and of the American Iron and Steel Institute, he describes the results of research on wire for prestressed concrete, giving the causes and corrections of corrosion in this type of wire.**

**In** a symposium held by the American Society for Testing Materials in 1918 on what was then called season cracking, a total of six papers was read, all on brass. Twenty-six years later, in 1944, the same society, this time in cooperation with the American Institute of Mining and Metallurgical Engineers, held another symposium on the same subject, by then called stress corrosion. This conference brought forth 29 different papers dealing with the alloys of seven important metals. Only one of the papers dealt with what some of us regard as the number one metal, plain carbon steel.

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**Even** today, as we listened to Drs. May and Lincoln recite a formidable number of known stress corrosion failures amongst a series of metals which owe their very existence to man's endeavor to find metals of exceptional corrosion resistance, this author finds himself in the position of having to report on the fact that stress corrosion failures on high tensile wire have been very few indeed. The reason is that plain carbon steel is not expected to be corrosion resistant, and it is normally protected carefully against any hostile environment.

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**Before** going further, it may be well to define the area of interest covered by this investigation. It has to do with the use of high carbon wire with tensile strengths of approximately 200,000 psi and over, as a structural material working constantly at stresses in excess of 100,000 psi—I mean, of course, prestressed concrete. In prestressed concrete—as in the case of its older sister, reinforced concrete—steel is intended to supply the necessary tensile strength while the concrete serves a dual function; namely, to absorb compression stresses and to protect the steel against corrosion.

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**Next** it will be of interest to report on what has happened so far in the field of prestressed concrete as regards stress corrosion failures of both linear structures such as beams and bridges, as well as circular structures such as tanks or pipes.

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**Since** its birth in the 1920's there must have been built at least 1000 linear structures, ranging from factory buildings to bridges with free span lengths up to 300 ft. The geographical locations include Europe, India, South America, and by now our own country. To date, no single failure has been reported amongst any of these structures, regardless of cause. Certainly, there has been no evidence of stress corrosion.

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**In** the field of circular structures, we have knowledge of literally thousands of miles of prestressed concrete pipelines operating at relatively high pressures. Some of these lines have now been in use for nearly 20 years, and not a single failure has so far been reported on any of these older lines. However, in two of the more recently built lines of this type, failures were reported within approximately a year of their construction. Both lines involved the use of oil tempered wire instead of the previously used hard drawn wire, and an examination of their failures showed unmistakable evidence of stress corrosion. A third failure of even more recent origin happened so soon after construction that some of the pipes could not even be placed into the ground. Again, the failure appeared to have been due to embrittling corrosion; this time, however, involving the use of hard drawn wire.

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**With** prestressed concrete becoming ever more popular in this country — one Pennsylvania firm alone is building prestressed concrete highway bridges at the rate of about 100 per year — the demand for more information regarding stress corrosion of high tensile steel wire became urgent. A survey of the literature resulted still in only the single paper previously referred to in connection with the stress corrosion symposium held in 1944. It is the one by R. E. Pollard of the National Bureau of Standards. You will recall that it dealt with the failure of ungalvanized wire used in the General U. S. Grant suspension bridge over the Ohio River at Portsmouth. After 12 years of service, stress corrosion had damaged the wire to such an extent that replacement with galvanized bridge wire had become necessary.

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**Using** the well-known means of sustained bending to induce outer fiber strain of calculated, different amounts, Pollard had exposed samples of the original cable wire in

solutions including 0.01 N ammonium nitrate, ammonium sulphate, ammonium nitrate and distilled water.

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**Stress** corrosion had appeared in a matter of months in the nitrate solutions, and in them only, while the other solutions displayed varying degrees of generalized corrosive attack, but without evidence of embrittlement.

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**Nitrates** are present in minute amounts of rain water. The mechanism which was therefore suspected to have caused the troubles at Portsmouth was as follows: Rain water was trapped in the anchorage shoes where the failures had been observed. Upon subsequent evaporation some quantities of nitrate salts were left, which went back into solution during the next rainfall. As time progressed, this process was repeated until the concentration finally reached an effective level.

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**For** the purpose of explaining the previously-mentioned failures of prestressed concrete pipe, one need only think of the fact that all soils contain measurable quantities of nitrates, and that concentration of such solutions must also be considered possible by alternate wetting and drying cycles.

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**The** Pollard investigation was somewhat restricted because of the small number of samples available. From a previous investigation made on the original, as well as the replacement wire, of the Mt. Hope Bridge, Pollard had available one sample of oil tempered bridge wire and two samples of galvanized (therefore hard drawn and stress-relieved) bridge wire. These samples were included in the nitrate solution exposures. With failures occurring in the original Portsmouth wire within periods of from 3½ to 9½ months, the oil tempered specimen seemingly behaved as well. It showed initial cracks after 3½ months, and failed after five months. One of the galvanized samples, on the other hand, from which the zinc had been stripped, did not fail even after an exposure of 39½ months. Pollard himself commented in his text, that "of the two materials last named no definite deductions are justified."

## Object of New Research

**We** started our investigation immediately after the failure involving oil tempered wire, to determine whether or not there is a significant difference between the susceptibility of oil tempered wire and hard drawn wire. Such a difference could perhaps be suggested by their different response to hydrogen embrittlement. Also included in our investigation were the possible effects of initial surface corrosions, as well as mechanically produced differences in surface conditions. Finally, we added a chloride solution to simulate the effect of marine exposure, as suggested in Pollard's paper. In an effort to accelerate results, we used very high concentrations; and occasionally, high temperatures.

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**In** the first part of this investigation we followed Pollard's footsteps, in that we employed the confined bending method by means of stressing jigs which were so designed that the outer fiber strain included 0.0, 0.4, 0.7 and 1.0 per cent (see Fig. 1). The material involved was as follows:

| Size | C | Mn. | Tensile Strength: Hard Drawn | Stress Relieved | Oil Tempered |
|---|---|---|---|---|---|
| .192 | .67 | .98 | 223,000 psi | 225,500 psi | 211,500 psi |

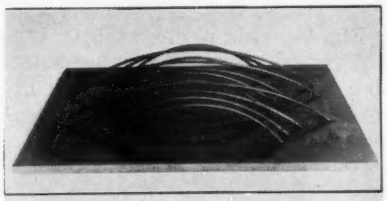

FIGURE 1– STRESSING BOARD WITH 0.192 INCH WIRES IN PLACE

**The** solutions employed were: 8.0 N ammonium nitrate, 8.0 N ammonium sulphate, 8.0 N ammonium chloride and 8.0 N ammonium carbonate. The nitrate solutions were controlled at several different Ph levels and at two different temperatures.

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**The** results of this part of our investigation are summarized in the next three pictures.

**Fig. 2**— details the results of exposure in 8N ammonium nitrate at three different Ph levels and at 200 F. Failures marked by X seem to occur at random, regardless of wire-making practice. Many samples stayed intact long after severe generalized attack had reduced their cross-section so greatly that longer exposure appeared useless.

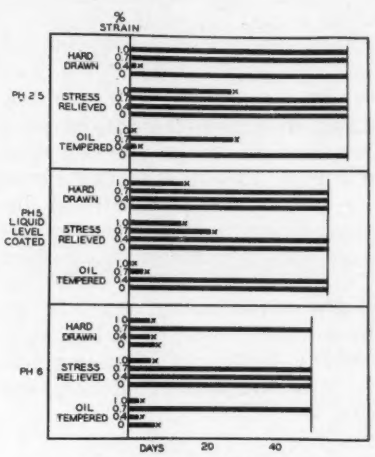


FIGURE 2– FAILURES OF 0.67% C 0.192" WIRES STRESSED IN BENDING AND IMMERSED IN 8N $NH_4NO_3$ AT 200°F. TESTS TERMINATED AFTER EXTREME GENERAL CORROSION

**Fig. 3**—gives the results of differently prepared samples in 8N ammonium nitrate at Ph of 4.5 and approximately room temperature. Some samples had been exposed to a humidity cabinet for four hours, others had been notched with a sharp tool, and a third group was protected with pieces of rubber hose in such a way that only a very narrow band of wire surface was exposed to the solution. Again, failure occurred at random with no noticeable effect due to differences in surface

conditions.

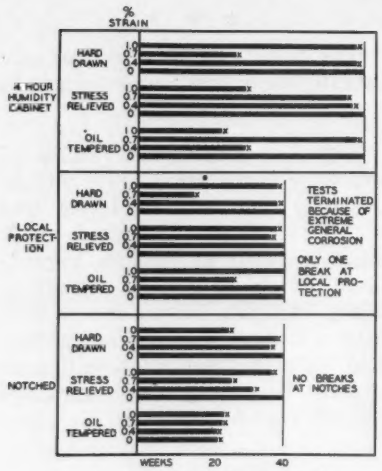


FIGURE 3- FAILURES OF 0.67% C 0.192" WIRES STRESSED IN BENDING AND IMMERSED IN 8N $NH_4NO_3$ AT 80°F PH 4.5

**Fig. 4**—shows the results of a test identical to the one described in Fig. 3, except that the Ph of the solution was controlled between 8 and 9. This test also displayed the same random pattern of failures, regardless of variations in the conditions of test. In all three tests there was at best only a slight display of greater sensitivity on the part of oil tempered wire.

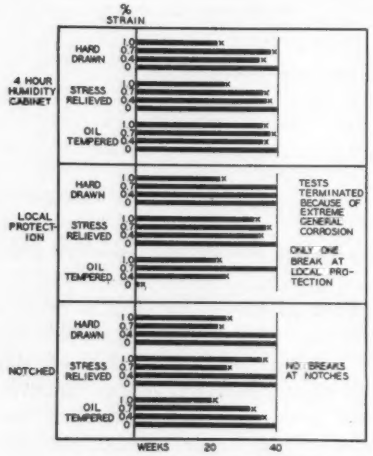


FIGURE 4- FAILURES OF 0.67% C 0.192" WIRES STRESSED IN BENDING AND IMMERSED IN 8N $NH_4NO_3$ AT 80°F PH 8-9

A check regarding ductility left in the wire, both in those which had not actually failed at all, and in those which had failed, proved all of them to be very brittle throughout their full length.

**Fig. 5**—This circumstance is picturized here by showing magnified sections of about ½ inch taken from three different positions of the wires. Considerable variation exists from end to end of each sample, and the severity of cracking is imperfectly correlated to time.

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A striking difference exists between the crack propagation in oil tempered wire and stress-relieved wire, which incidentally displayed the same pattern as did the hard drawn wire. The reason is that the oil tempered wire, which owes its strength entirely to the final heat treatment, has essentially an equiaxed grain structure. The cracks therefore travel in a more or less transaxial direction. On the other hand, the wire, which owes its strength to cold work alone, has greatly elongated grains which force the cracks to progress in a more or less semi-axial direction.

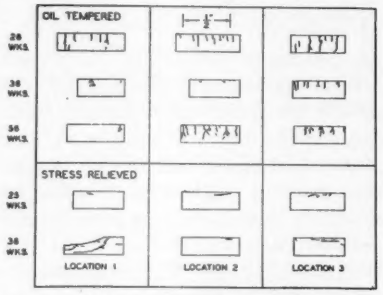


Fig. 5 — Condition of 0.67 per cent C, 0.192 inch wires after exposure under stress to 8 ON $NH_4NO_3$ at 80 F

**Fig. 6**—At 100 times diameter this photograph of two different cracks shows the intercrystalline nature of the attack. It is particularly apparent in the oil tempered wire.

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**Fig. 7**—This photograph of typical failures emphasizes the selective nature of the attack, with little necessity for concurrent generalized corrosion.

★ ★ ★

**The** other solutions applied in this first series of tests; namely, ammonium chloride, ammonium sulphate, and ammonium carbonate, were capable of causing only a generally uniform corrosive attack, with no great impairment in ductility.

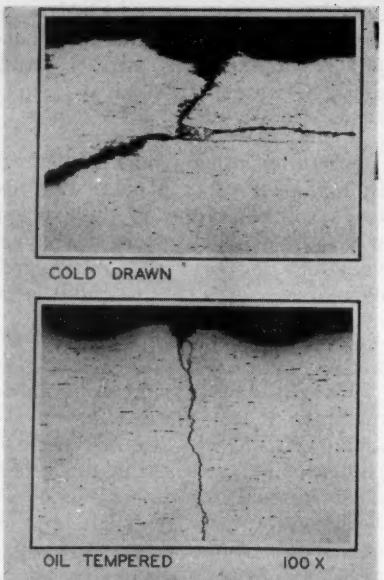


FIGURE 6- TYPICAL STRESS-CORROSION CRACKS IN 0.67% C 0.192" WIRE AFTER IMMERSION IN 8N $NH_4NO_3$ AT 80°F

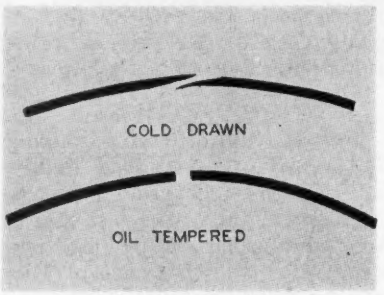


**Figure 7—Typical stress corrosion breaks in 0.67 per cent C, 0.192 inch wire.**

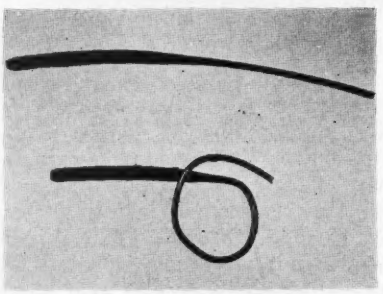

**Figure 8—Generalized corrosion attack of 8N $(NH_4)_2SO_4$ on 0.80 per cent C, 0.192 inch wire, showing retention of ductility.**

**Fig. 8**—demonstrates this point. The sample had been exposed to hot ammonium sulphate for eight days, yet its remainder could be formed as shown.

## Summary of Results of First Part of This Study

**The** results of this first series of tests can be summarized as fol-

lows:

1. Of the salt ions common to ground water and atmospheric waters, the nitrate alone shows characteristic stress corrosion attack.

2. This attack is intergranular, manifesting itself in transaxial propagation of cracks in the oil tempered wire, and in almost axial cracking in the cold drawn, as well as the cold drawn and stress-relieved wire.

3. Little effect could be attributed to such variables as:

a. Method of producing strength, whether by heat treatment or cold work.

b. Stress level, as long as there is considerable stress.

c. Ph of the solutions.

d. Impairment of wire surface, as by notch, corrosion or local protection.

4. All wires, regardless of manufacturing history, became brittle in the nitrate solution. Since this observation was made also on those wires which did not apparently fail at all, it must be concluded that this method of statically straining the specimen, gives at best a measure of their continued load carrying ability, but no measure of their progressive change in ductility. It is even possible that the occurrence of minute cracks serves to relieve the outer fiber stress progressively in such a way as to prevent final collapse.

## Second Series of Tests Free Loop Tests

In an effort to devise a more precise measure of loss of ductility due to stress corrosion, the following method was tried. Small pieces of wire of relatively small diameter were wound into free loops of approximately three times the diameter of the wire itself (see Fig. 9). Large numbers of such samples were then immersed into the solutions and removed in groups of four at logarithmically spaced time intervals. These samples were then straightened by hand, and the number of failures in each group counted. Wires used in this second series of tests were as follows:

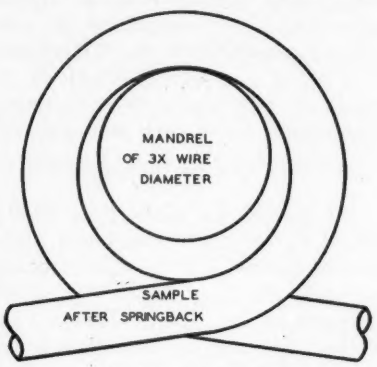


Fig. 9 — Preparation of free loop samples.

| Size | C | Mn | Tensile Strength Hard Drawn | Screw Relieved | Oil Tempered |
|---|---|---|---|---|---|
| .086 | 0.50 | 0.47 | 205,000 psi | 211,000 psi | 234,000 psi |
| .070 | 0.66 | 0.90 | 250,000 psi | 244,500 psi | 243,000 psi |
| .060 | 0.80 | 0.70 | 292,000 psi | 263,500 psi | 240,500 psi |
| .080 | 0.80 | 0.70 | 295,000 psi | 261,000 psi | 248,000 psi |

**Fig. 10**—This method differentiated clearly between oil tempered and hard drawn wire. The material involved was .66 C at a .070 inches diameter. Failure of the oil tempered wire in boiling 1.0 N ammonium nitrate started shortly after 20 minutes and was complete at about 100 minutes. Cold drawn wire did not show signs of depreciation even after 1000 minutes (at this writing not even after almost 4000 minutes). An interesting side light is cast on the picture by the production of a nearly perfect wire surface by means of electropolishing. This drastic expedient succeeds only in deferring the beginning of failures in the oil tempered wire to about 300 minutes.

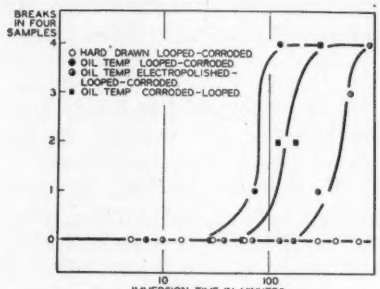


Fig. 10 — Failures in opening loops in 0.66 per cent C, 0.070 inch wires after exposure to boiling 1.0N $NH_4NO_3$.

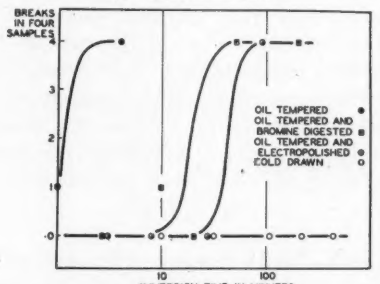


Fig. 11 — Failures in opening loops in 0.66 per cent C, 0.070 inch wires after exposure to cold 3.0N HCL.

**Fig. 11**—A rather similar picture is shown by a digression in which the ammonium nitrate is replaced with 3.0 N hydrochloric acid. The only difference is that things happen just a bit faster, and that the improvement due to electropolishing seems to be somewhat more pronounced. To test whether or not the electropolishing effect might be one of passivation an alternate method of surface removal was tried, using bromine dissolved in methyl acetate. The results are so nearly the same that the improvement must be considered due to one of surface improvement.

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**The** hydrogen embrittlement in hydrochloric acid must be somewhat different from the mechanism of stress corrosion, in that it can be "removed" almost completely by baking.

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**Fig. 12**—Here are shown photographs of a stress corroded sample and a hydrogen embrittled sample. We were unable to see the type of cracks illustrated in the upper sample in any of the hydrogen embrittled ones.

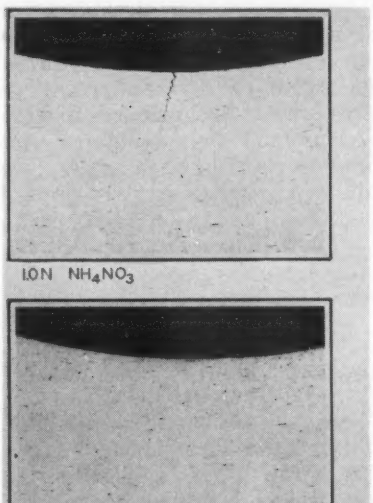


FIGURE 12 - INSIDE OF LOOPS OF 0.66% C .070" WIRES AFTER EXPOSURE TIMES SUFFICIENT TO CAUSE FAILURE IN UNLOOPING

**Fig. 13**—shows the results of free loop tests on a .50 C steel in 1.0 N boiling ammonium nitrate, and

**Fig. 14**—those on an .80 C steel. Not much difference can be noted from the already discussed .66 C steel.

(*Please turn to page* 346)

# Signal Corps Wire and Cable Symposium

At the Third Annual Symposium held in Asbury Park, N. J. on December 7, 8, and 9, 1954, twenty-four papers were presented under the auspices of the Wire Communication Branch, Coles Signal Laboratory, **Signal Corps Engineering Laboratories.**

★ ★ ★

As it will not be possible for Wire and Wire Products to publish all of these papers, we are presenting in the following paragraphs a brief synopsis of those papers that will not be printed in our editorial columns.

★ ★ ★

**These** synopses follow:

"Butyl Insulation" by **W. C. Smith,** Standard Oil Development Co., 15 West 51st St., New York City. In this paper the author has grouped the properties desired in butyl rubber insulation, with information on how to process to give smooth extrusions, ozone resistance and ways to obtain resistance to cracking, heat aging, stability in water, di-electric strength and good curing. Fillers, plasticizers, stiffeners and mixing techniques are discussed.

★ ★ ★

**"The** Aging of Polyethlene Compositions" by **N. D. MacLeod,** Imperial Chemical Industries Ltd., Welwyn Garden City, Hertfordshire, Eng. This paper describes the growth of applications of polyethylene, new properties developed and the work of polyethylene aging at elevated temperatures. Autoioxidants, blooming, bleeding, milling and other factors are covered.

★ ★ ★

**"Balanced** Radio Frequency Cables" by **C. C. Camillo, G. F. Kovar** and **R. M. Soria,** American Phenolic Corp., 1830 S. 54th St., Chicago, Ill. The authors here treat of coaxial cables for electronic equipment operating at radio frequencies for interconnecting purposes where balanced cables are required. The two most common types are the twin dual coaxial cables. Until very recently such cables had a poor degree of balance. The investigations leading to the development of satisfactory balanced circuits are discussed.

★ ★ ★

**"An** evaluation of Vinyl Hook-Up Wires" by **A. H. Lybeck** and **S. J. Trykowski,** William Brand & Co., North & Valley Sts., Willimantic, Conn. In this paper, the authors evaluate three polyvinyl-chloride insulation compounds used for hook-up purposes as to basic electrical, physical and chemical properties; suitability for use throughout a range of operating temperatures; and the effect of high temperatures on the physical and electrical characteristics of the insulating jackets.

★ ★ ★

**"The** Effects of Conductor Temperature on the Quality of Extruded Vinyl Wire Insulation" by **E. E. Griesser** and **M. M. Suba,** Development Laboratories, Bakelite Co., Bound Brook, N. J. This is a study of the interrelation of conductor temperature, compound temperature, wall thickness and the several properties that enhance the quality of vinyl wire insulations, Heat shock, shrinkage, tensile properties, aging and other factors are considered, with observations on the effects of conductor preheating.

★ ★ ★

"A Resin Sealed Approach to Communications Splicing" by **E. W. Bollmeier.** Chf. Eng., Electro-Mechanical Products, Minnesota Mining and Mfg. Co., 900 Fauquier Ave., St. Paul, Minn. A discussion of cable splicing techniques in both industrial and field splicing, using epoxy thermosettng plastic resins as insulating and sealing materials, a summary of the progress made in the field of communication splicing is presented.

**"Specification** Changes and New Development in Cable and Wire for the Rural Electrification Administration" by **W. T. Smith, C. R. Ballard** and **A. L. Ritchey,** Rural Electrification Adminstration, Washington 25, D. C. The authors outline the results of the REA's efforts to reduce the cost of providing telephone service in rural areas. The paper treats of plastic sheath-plastic insulated cable, splicing, cable accessories, terminals, line wire instructions and other factors considered in making lower costs.

★ ★ ★

**"Hot** Gas Welded Splice Closures for Plastic Cables" by **A. D. Varenelli** and **E. R. Kerwin,** Ansonia Wire and Cable Co., Ansonia, Conn. This describes a process of splicing developed to provide a continuous covering over a splice made of the same materials as the plastic jacket. The methods of making such splices and applications where they are justified, as against other types of slicing methods, are set forth.

★ ★ ★

**"Mechanical** Splice Closures for Telephone Cables" by **P. P. Koliss,** Bell Telephone Laboratories, Murray Hill, N. J. This article tells how a new procedure using a die cast aluminum casing bolted to the cable and sealed with a highly adherent butyl compound, is employed to overcome the difficulties of closing a sheath that cannot be soldered and sealed by the usual techniques used with lead sheath.

★ ★ ★

"A Report on Work Now Being Done to Improve Electrical Connector Reliability" by **C. C. Quackenbush,** Whitney Blake Co., 1565 Dixwell Ave., New Haven 14, Conn. The author describes a recent development involving shell design, terminals, contact reliability and other points of design providing interchangeability of con-

(*Please turn to page* 351)

# Things Are Getting Smaller All the Time

by E. Joseph Kassel
Kassel Export Company
New York, N. Y.

**These interesting observations concern a super-fine magnet wire said to be smaller in diameter than anything manufactured in this country. The wire is distributed in the United States by the Kassel Export Company.**

**To** meet the ever growing need for diminutiveness in the coil winding industry there has been developed a magnet wire of such small diameter that it is hard to believe its base is pure copper. The wire has been in development for several years and was finally perfected in 1954.

★ ★ ★

**The** diameter of the bare copper wire is .00059", or more than two tenthousands smaller than the finest enameled copper wire heretofore available commercially. No AWG number has been assigned to this wire but carrying out the present ratings logically, a .0006" wire would probably be considered AWG 54. There are several thicknesses of enamel available and the standard thickness of enamel applied by the mill brings the enameled wire to a diameter of .000787".

**This** amazing magnetic wire, made by **Leonische Drahtwerke A. G.** in Western Germany, is currently available only with a very high grade of standard enamel, but experiments are being carried on to determine whether the wire can be produced with a self-soldering type of enamel.

★ ★ ★

**The** present enamel presents only one difficulty—the removal of the insulation from the wire in order to fasten the ends. This is presently accomplished by the usual gas flame and fine emery paper methods but care must be taken and skill developed for either of these two methods.

**The** specifications for the wire make for fascinating reading. The tolerance for the bare wire is plus or minus .000004", and the resistance approximately 30 to 35 ohms per foot. The standard enamel wire yields 895,000 feet per pound and it would take only 1 pound to stretch from New York City to Baltimore.

★ ★ ★

**The** wire's commercial use has so far been confined to the miniature coils, but experiments are being carried out presently by several firms for other purposes, especially since the wire can also be purchased bare.

★ ★ ★

**Things** are getting smaller all the time — and now magnet wire has joined the parade.

## *Coming Meetings of The Wire Association*

New York, N. Y.—April 28 and 29, at the Commodore Hotel. This is the New York Area Regional Meeting.

San Francisco, Cal.—June 10, at The Sir Francis Drake Hotel—The Pacific Coast Regional Meeting.

Chicago, Ill.—November 14 through 17 at the La Salle Hotel—The Annual Convention of The Wire Association.

All of these meetings are being carefully planned to provide wire men with maximum values and interesting times. All wire men are welcome to attend.

# Government Wire Production Information

### Third Temperature Symposium

**An** international symposium on "Temperature, Its Concept and Measurement" was held at the **National Bureau of Standards**, Washington, D. C. on October 28, 29, and 30, 1954, to review the present status of problems in the measurement of temperatures from millidegrees to megadegrees. Included for discussion were such subjects as extremely hot gases, low-temperature scales near absolute zero, highly precise methods for measuring temperature, upper atmosphere temperatures, and the temperatures of shock waves caused by supersonic aircraft.

* * *

**During** the five half-day sessions, a total of 25 technical papers were presented before more than 400 scientists representing industry, government, and university laboratories both in the United States and abroad. The symposium was sponsored jointly by the **American Institute of Physics**, the **National Bureau of Standards**, and the **Office of Ordnance Research**, Department of the Army. **Dr. A. V. Astin**, Director of the National Bureau of Standards, was chairman of the meeting.

* * *

**Temperature** ranks as one of the most important of the physical quantities, and its measurement and understanding have provided some of the most difficult and challenging problems, both experimental and theoretical, in the field of physics. Three international symposia have now been held to permit exchange of information between the various groups that work with extreme temperatures and precision temperature measurement, and to stimulate research pertinent to these fields of interest.

* * *

**Publication** of the symposium proceedings is being arranged by the American Institute of Physics. The book is expected to be published by the Reinhold Publishing Corporation by the fall of 1955, under the editorship of H. C. Wolfe of Cooper Union.

### Announcement of New NBS Publication

**Standard Samples and Reference Standards Issued by the National Bureau of Standards,** National Bureau of Standard's Circular 552, 23 pages, 25 cents. It may be ordered from the Government Printing Office, Washington 25, D. C.

* * *

**This** Circular contains a descriptive listing of the various Standard Samples issued by the **National Bureau of Standards.** A schedule of weights and fees, as well as direction for ordering, is included.


**MODEL "J" TYPE AUTOMATIC**

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**MICRO-WELD BUTT WELDER**

This type welder is available in four Models (J-45-C) (J-5-C) (J-7-C)(J-8-C) for welding COPPER, ALUMINUM, and other nonferrous wire and rods, ranging in size from .080" to ½" diameter.

The welding cycle on these units is automatically completed by one single downward stroke of the foot pedal, which clamps the stock being welded, contacts the welding switch, and supplies the upset pressure on the weld.

All welders are equipped with annealing dies, filing vise, hand shears, and mounted on a 4-wheel truck.

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Summarized tables of analyses are presented, to indicate the type of standards of composition presently available. The current status of the various standards will be indicated by a mimeographed insert.

★ ★ ★

**The** NBS program on standard samples has been in existence almost since the organization of the Bureau. The first standards were prepared in 1905, and today over 500 different standard samples of chemicals, ores, ceramics, and metals are prepared, certified, and distributed by NBS. They are sent to analytical and research laboratories for use in controlling chemical processes and in maintaining the accuracy of apparatus and equipment. The standard samples are materials that have been carefully analyzed, or whose physical properties have been precisely determined, at the Bureau and other laboratories.

★ ★ ★

**Foreign** remittances should be in U. S. exchange and include an additional one-third of the publication price to cover mailing costs.

### Issued Patents on Aluminizing Process

**Potential** markets for hot-dip aluminum coated iron and steel wires are probably wider in scope than for any other wires currently manufactured with metallic coatings, according to **E. B. Brant,** product manager, **Page Steel & Wire Division, American Chain & Cable Company,** Monessen, Pa.

★ ★ ★

**The** Page Division has completed a survey of some 20 odd markets where it is expected its new corrosion resistant wires, marketed under the name of "Acco Aluminized", will be used in volume as a replacement for galvanized wires. Tests show resistance to weathering in industral and rural atmospheres to be two to six times as long as galvanized of equal coating thickness. Large scale production, planned for 1955, is expected to make the price competitive.

★ ★ ★

Licensed manufacturers of recessed head screws who have specified "Special Processed" wire for their difficult cold heading jobs find that it more than pays for itself by: (1) increasing the production rate which *lowers the cost per unit*; (2) greatly prolong die life which *reduces machine down-time and labor costs*; (3) providing a higher quality finished product which *minimizes rejections and inspections.*

The excellent flow properties of this superior cold heading wire, together with its structural soundness, enables you to gain greater efficiency from start to finish on the more intricate and precise cold heading parts in your production schedule.

For further information, see your Keystone representative or write direct.

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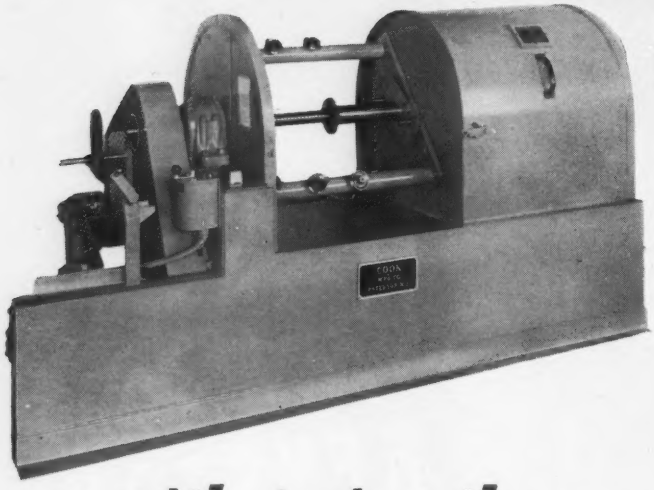

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**American** Chain & Cable Company was issued U. S. Patent Numbers 2,686,354 and 2,686,355 on August 17, 1954, covering the "Lundin Process for Coating and Uniting Metal Shapes with Aluminum" and the "Lundin Process for Coating Metals with Aluminum." A large number of foreign patents have already been issued corresponding to these patents and applications are still pending on variations of this process.

### Copper and Copper Alloys

**The** regular fall meetings of Committee B-5 were held October 5 and 6 in Washington, D. C.

★ ★ ★

**Rod, Bar, and Shapes.**—A 10 per cent and a 12 per cent nickel silver alloy are proposed for addition to Specification B 151. Specification B 124 for copper and copper-alloy forging quality rod, bar, and shapes has a number of revisions planned including (1) deletion of alloys 5, 6, 8, 9, and 10; (2) addition of names for remaining alloys; (3) new copper limits for alloy 2 (forging brass) of 58.0 to 61.0 per cent; (4) addition of straightness tolerances; and (5) in the Appendix reference to Specification B 283 for typical tensile values and forgeability ratings. New details for instrument accuracy and graduation for measuring dimensions are also planned for Specification B 249.

★ ★ ★

**Wire and Wire Rod.**—As planned for Specification B 248 (plate, sheet, and strip) and B 249 (rod, bar, and shapes) a new clause explaining rejection of wire and wire rod for exceeding dimensional tolerances, including details of instrument accuracy and graduation, will probably be added to Specification B 250.

### Wires for Electrical Conductors

**In** Washington, D. C., Committee B-1 and several subcommittees met on October 25 and 26. The subcommittees covering copper and copper-alloy conductors and alumi-

num conductors reported much progress in task group assignments.

★ ★ ★

**Copper and Copper Alloys.**—The trolley wire gages published for several years as information and investigation purposes will probably be incorporated into Specifications B 9, B 47, and B 116. Task groups reported as follows:

1. Data are being collected so that statistical sampling procedures can be incorporated in Specifications B 33, and B 189, covering tinned and lead-coated conductors.

2. Data for specification values for stiffness requirements of magnet wire are being collected and studied.

3. Additional strandings for Specifications B 286 covering electronic hookup wire are under discussion.

4. Considerable progress has been made on the preparation of proposed specifications for coated wire for high-temperature applications.

5. The investigation of methods of calculating derived data for shaped wire is well under way.

6. Addition of a new 30 per cent conductivity alloy to Specification B 105 is being considered. At present the question of stress-corrosion resistance of the new composition is under review.

★ ★ ★

**Aluminum Conductors.** — A report on the September meetings of Technical Committee 7 (Aluminum) of the International Electrotechnical Commission in Philadelphia was given. At those meetings tentative agreement on a standard for annealed high-purity aluminum (resistivity 1/37 ohm, approximating 63.8 per cent IACS) was reached. Also tentative agreement resulted on a minimum conductivity of 61 per cent IACS for hard-drawn aluminum wire.

★ ★ ★

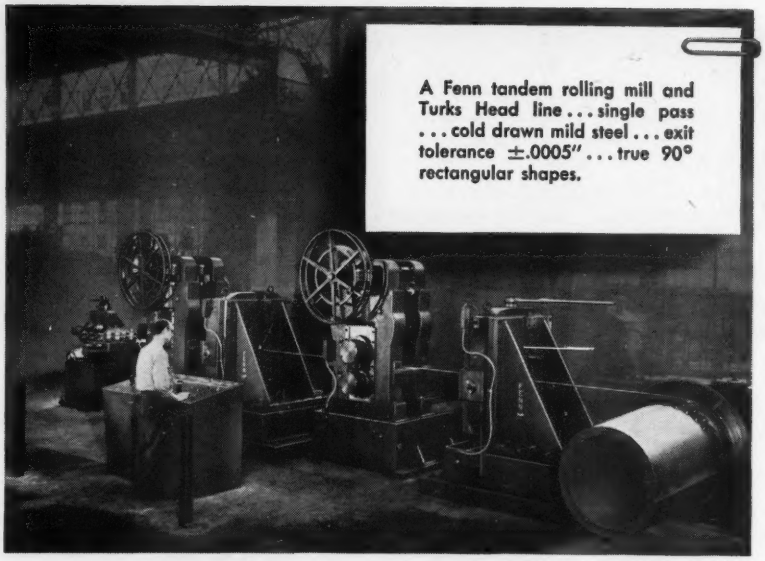
**Discussion** of other subjects disclosed the following:

1. The listed ACSR constructions in Specifications B 232 are being studied with a view toward deleting some and adding others.

2. Several producers reported promising results with the new cold welding process for joining aluminum wire. Observations will continue.

3. Correlation of diameter tolerance requirements for small wire sizes of aluminum and copper conductors is being studied.

Join The WIRE ASSOCIATION and work with others to improve the industry. Send for booklet.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*in a single pass*

- Can you make these and other shapes from round, in one pass, at speeds up to 2000 fpm?
- Can you hold tolerances of ±.0005" over 500 miles of stock, without regrind of dies or tools?
- Can you make an infinite number of squares and rectangles on the same set of dies?
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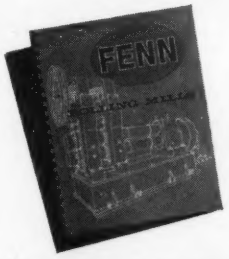


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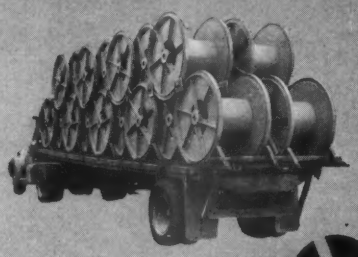

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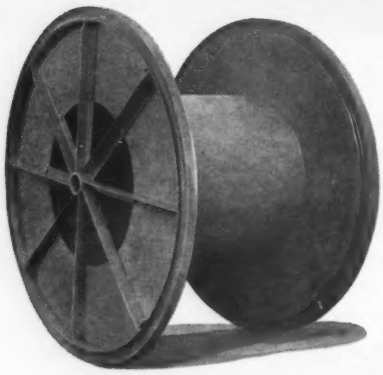

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## Columbia Produces Wire Rod

**The** little South American country of Columbia with its population of around 11 millions has taken a forward step with the erection of an iron and steel mill in Belencito, as a move toward development of heavy industry. There is no lack of raw materials. It is asserted that Columbia has a coal supply of around 17 millions of tons, taking first place in this commodity among the South American countries. The coming into operation of the iron and steel plant a short time ago has given an impluse to some extensive plans. A blast furnace is now in operation in Belencito with a daily capacity of 500 tons. A second furnace of 1,000 tons capacity is to be added.

★ ★ ★

**The** Belencito plant is equipped for the production of semi-finished products. The program calls for the production of 36,000 tons of wire rod, 54,000 tons of bar steel and 6,100 tons of fastening iron, etc. It is emphasized that this is only a beginning of the program. Production will be greatly increased upon completion of the second furnace. In this program wire production will take second place. The change in the economic basis of this country from coffee growing to industrialization is making significant progress.

**From DRAHT-WELT, Dec. 10, 1954.**

### ABSTRACTS

ANWENDUNG DER SPANNUNGS-OPTIK ZUR VERBESSERUNG DER ARBEIT IN UNSEREN PROFILZIE-HEREIEN. THE APPLICATION OF STRESS-OPTICS IN OUR PROFILE DRAWING SHOPS.
E. Doerling, Schulze Technik 1954 Vol 9 (11) pp 631-634 (Nov) (In German)

**Knowledge of conditions of strain on wire and rods during cold drawing through dies essential for proper calculation of reduction angle and opening, drawing speed etc. State of strain of various models of photo-elastic plastics examined in polarized light between crossed Nicols. Particular material used for model allows freezing of strains after plastic deformation, thus permitting examination of strains during drawing through dies. Rod of phenol-formaldehyde type of plastic drawn through metal die at 135 deg, then examined at room temp. Difficulty of quantitative evaluation. Necessity for photographic record of change of stress during drawing. 10 illustr, 14 ref.**

**H*** **C 11.0**

★ ★ ★

PROBLEME DER FEINDRAHTTECHNIK. PROBLEMS OF FINE WIRE TECHNIQUE.
A. Forstmeyer. Feingeraetetechnik 1954 Vol 3 (11) pp 473-476 (Nov) (In German)

**Paper to conf, 'Feingeraetebau 1954', Dresden. Short historical account. For copper wire drawing, diamond dies used. Reduction cone angles 8 to 16 deg for hard steel wires; 12 to 20 deg for medium hard steel wires, copper and bronze; and 20 to 25 deg for soft wires, in particular aluminium. In final drawing operations on copper wire, cross sectional area reductions of only 5 % usual, reducing dia by 2 to 2.5%, and making drawing dies of 21, 20.5 and 20 micron dia necessary. Production of holes with only 0.5 micron tolerance causes great difficulties; therefore selection technique necessary. Short description of machining of diamond dies and drawing operations. 10 illustr.**

**G** **C11.0 : D 11.0**

★ ★ ★

AUTOMATIC WIRE-DIAMETER CONTROL
F. Fua (Standard Electronics Res Corp). Electronic Equipmt 1954 Vol 2 (5) pp 10-11 (May) 3 illustr.

**Y*** **C 11.0**

★ ★ ★

THE FUNDAMENTAL DESIGN OF WIRE - DRAWING DIES (ORIGINAL IN CZECH)
J Hoell. Wire Prodn 1954 Vol 3 (9) pp 8-9 (Aug) Transl from Hutnik. 1 illustr.

**Y*** **C 11.0 : D 11.0**

★ ★ ★

SURFACE TEMPERATURE - LUBRICATION RELATIONS DURING DRAWING OF COPPER WIRE.
J. S. Hoggart (Melbourne Univ). Wire Prodn 1954 Vol 3 (2) PP 4-5, 7, 9 (Jan) 2 illustr, 11 ref, 4 tables.

**Y*** **C 11.0**

★ ★ ★

SURFACE TEMPERATURES IN DRAWING AND THE TENSILE STRENGTH OF COPPER WIRE.
J. S. Hoggart, S. Z. M. Kopzynski (Melbourne Univ). Wire Prodn 1954 Vol 3 (3) pp 11, 13, 20 (Feb) 2 illustr, 3 ref.

**Y*** **C 11.0**

★ ★ ★

REGISTRIERGERAET FUER WIDERSTANDSAENDERUNGEN (QUERSCHNITTSSCHWANKUNGEN VON DRAEHTEN ZWISCHEN 10 UND 250 MICRON DURCHMESSER. REGISTERING INSTRUMENT FOR CHANGES IN CROSS-SECTIONAL AREA OF WIRES BETWEEN 10 AND 250 MICRON DIAMETER.
E. Kersting, G. Wollanky. Draht 1954 Vol 5 (11) pp 418-420 (Nov) (In German).

**New electronic instrument compares resistance of wire as it passes with resistance of standard wire. Detailed description of measuring results, and applications, 4 illustr, 6 ref.**

**G** **C 11.0 : D 15.0**

★ ★ ★

METAL GRAIN STRUCTURE DURING WIRE DRAWING.
H. Kostron. Metall 1952 Vol 6 (19/20);


Basic Materials

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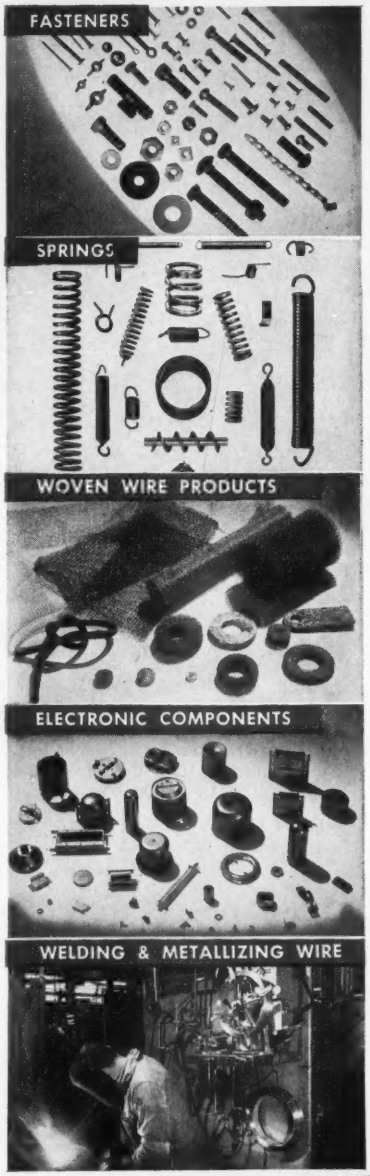


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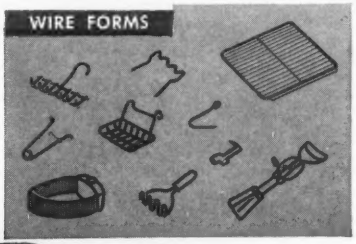


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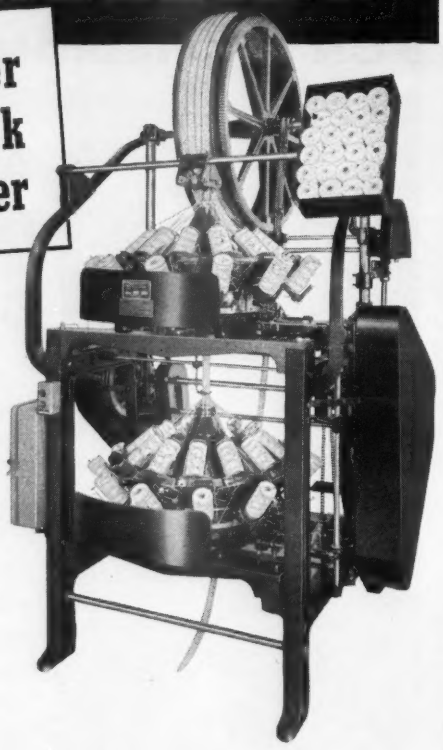
## 24-24 Carrier Double Deck Cable Braider



This machine has all the features of the WARDWELLIAN Cable Braider, plus the added feature of applying two layers of braid simultaneously. Each head can be adjusted individually to give the desired number of picks or plaits for each layer of braid.

Machine is driven by a three horsepower adjustable speed motor that gives great flexibility of operation through the dial control. Power is transmitted from motor to braider through the medium of a Maxitorq Floating Disc Clutch mounted on the countershaft.

- Production 44″ to 340″ per minute depending upon the texture of the product.
- Standard set of eighteen change gears for varying takeup furnished with each machine.
- Standard set of ten change gears for varying speed of lower head furnished with each machine.
- Carrier speed 75 R.P.M. for cables ¾″ diameter to the maximum of 1⅛″ diameter or 500,000 circular mils; production 900 picks or plaits per minute.
- Carrier speed 100 R.P.M. for cables ¾″ diameter and under, 1200 picks or plaits per minute.
- Speed of braider countershaft 345 R.P.M. for carrier speed of 75 R.P.M. or 460 R.P.M. of countershaft for carrier speed of 100 R.P.M.
- Ratio braider countershaft speed to carrier speed 4.6 to 1.
- Carrier speeds can be varied from a maximum of 100 R.P.M. to a minimum of 33 R.P.M.
- Capstan 36″ diameter, 6″ face.
- Beater openings in both upper and lower heads 1¾″ diameter.
- Supply yarn packages Universal wound, 2 11/16″ dia., 5″ traverse, on tube 5¼″ long, ⅝″ hole, four point wind.
- Supply and windup stands not furnished.
- Machine can be adapted for producing one-and-one braid by changing thread deflectors.
- Counter for measuring in feet or yards furnished upon request.
- Weight approximately 2500 lbs.

REPRESENTATIVES FOR EUROPE, BRITISH COLONIES AND DEPENDENCIES
JAMES MACKIE & SONS, LTD.
BELFAST, IRELAND

Wardwell
BRAIDING MACHINE CO.
CENTRAL FALLS, RHODE ISLAND, U.S.A.


Wire Prodn 1954 Vol 3 (12) pp 4-5 (Nov) (Original in German) 2 illustr.
Y* C 11.0

★ ★ ★

TUNGSTEN IN THE LAMP INDUSTRY.
G. R. Moritz, W. E. Anderson, Westinghouse Eng 1954 Vol 13 (3) pp 82-87 (May).

**Drawing operations: wire lubricated with colloidal graphite, heat applied, and drawn through composition and diamond dies. As dia decreases, drawing speed increased and temp decreased. Tungsten drawn to dia of 0.000394 in. within dia tolerance ± 1%. 6 illustr, 2 tables.**
Y* C 11.0

★ ★ ★

DEVIATIONS FROM MATTHIESSEN'S RULE FOR COLD-DRAWN WIRES.
G. J. Ogilvie (Melbourne Univ), W. K. Clothier (Sydney Univ). Austral Journ Phys 1954 Vol 7 (1) pp 210-216 (Mar).

**Deviations shown to exist in resistivity/temp curves of cold-drawn wires from those for annealed wires, in case of copper, aluminium, bronze and 80/20 brass. 2 illustr, 5 ref, 1 table.**
Y* C 11.0

★ ★ ★

SOME RESEARCHES IN WIRE DRAWING.
F. C. Thompson (Manchester Univ). Wire Prodn 1954 Vol 3 (3) pp 5-10 (Feb).

**Practical factors in wire drawing (area reduction, die angle, yield stress, flow); mathematical treatment; friction; and mechanical properties of drawn wire. 11 illustr, 15 ref, 6 tables.**
Y* C 11.0

★ ★ ★

RESEARCHES CONCERNING WIRE-DRAWING.
J. G. Wistreich. Wire Prodn 1954 Vol 3 (4) pp 7-10 (Mar); (5) pp 9-11 (Apr), 5 illustr, 55 ref, 2 tables.
Y* C 11.0

★ ★ ★

DIAMOND DRAWING DIES
Anon. Ind Diamond Rev 1954 Vol 14 (169) p 258 (Dec).

**Short review of new German standard DIN 1546, June 1954.**
G C 1.62 : C 11.0

★ ★ ★

NEW GERMAN STANDARD FOR DIAMOND DIES.
Anon. Wire Ind 1954 Vol 21 (251) p 1125 (Nov).

**Short extract from recently issued German Standard DIN 1546. 1 table.**
G C 1.62 : C 11.0

**These abstracts have been prepared by and are furnished through the courtesy of the Industrial Diamond Information Bureau 34 Holborn Viaduct, London, E. C. 1, England. Please direct inquiries regarding them to the Bureau.**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# Outstanding Personalities of the Wire Industry

### Okonite Expanding Hazard Division

A half-million dollars expansion program is now under way at the Hazard division of the **Okonite Company** at Wilkes-Barre, Pa.

★ ★ ★

**D. W. Nurse,** vice president in charge of manufacturing, announce that a lead extruder machine costing $150,000 was recently installed and that three modern Watson standers valued at $150,000 have been ordered for the local plant.

★ ★ ★

**In** addition, Mr. Nurse stated that a disbursement of $200,000 is approved for such improvements as a continuous vulcanization machine, power installation, an automatic ingredient handling system for a banbury mixer, plus other minor repairs during the year 1955.

★ ★ ★

**The** new lead extruder machine that was recently installed is used to form a lead pipe around the cable which acts as a continuous mold for vulcanizing or curing the outer covering of the table. This process is used on the majority of Hazard-Okonite cables.

★ ★ ★

**A. W. Robertson,** plant manager announces that an incentive program has also been started which provides an opportunity for employes to improve their earnings. It is hoped the incentive plan will be completed by Spring.

### Elected Vice President of Glass Fibers

**John A. Morgan** has been elected Vice President **Glass Fibers Inc.,** and appointed General Manager of the Western Division, according to an announcement made by **Randolph H. Barnard,** president of the firm.

★ ★ ★

**M. Dean Worcester,** formerly General Manager of the Western Division, resigned as Vice President of the company effective December 1 and will announce his plans at a later date.

★ ★ ★

**In** his new assignment, Mr. Morgan will headquarter in the Glass Fibers' Burbank, California plant and will manage all sales and production operations in the Western states. The company manufactures and sells glass fiber textile yarns to the electric wire industry and for other purposes.

### Engineer Joins Gas Machinery

**James E. Hovis** has joined **The Gas Machinery Company** of Cleveland, Ohio, as special industrial furnace representative in the steel and metal working industry.

Glader—Years of Proven Performance
GLADER NAIL MACHINES
55 YEARS of experience meeting the exacting demands of nail making.
The machine with a record of steady dependable service.
Wm. GLADER MACHINE WORKS
210 N. RACINE AVENUE
CHICAGO 7, ILLINOIS
Export Dept: 122 East 42nd Street, New York 17, N. Y.

Prior to this appointment, Mr. Hovis was Vice President in charge of sales for The Bloom Engineering Company of Pittsburgh. He had also been development and design engineer for this company, which posts were followed by a field sales engineering position.

★ ★ ★

He graduated with a Bachelor of Science degree in Mechanical Engineering, Carnegie Institute of Technology, in 1946, and was also an instructor in the mechanical engineering department of this institution during 1946-47.

## To Manage G.E.'s Chemical Development Department

The appointment of **Dr. Robert H. Krieble** as manager of the Chemical Development Department, of the **General Electric Company's** Chemical and Metallurgical Division, was announced by Robert L. Gibson, Division general manager.

★ ★ ★

Dr. Krieble will succeed **Dr. Alphonse Pechukas,** who has been appointed to the post of Consultant - Materials and Processes, Engineering Services Division. Dr. Pechukas' appointment has been announced by **Clarence H. Linder,** Vice President for Engineering Services.

★ ★ ★

According to Mr. Gibson, the Chemical Development Department is established to create wholly new chemical businesses for the Chemical and Metallurgical Division's five operating departments. An independent operation, it is responsible for developing new processes and products at its Pittsfield laboratories.

## Heil Process Makes Two Promotions

**Heil Process Equipment Corp.,** Cleveland, manufacturer of chemical-proof equipment such as tanks and tank linings, lead anodes, heat exchangers, plastic duct systems, etc., announced the appointment of **Fred W. Arndt** as Chief Engineer. **Peter L. Veit** was appointed Sales Engineer with headquarters at 152 West 42nd Street, New York.

★ ★ ★

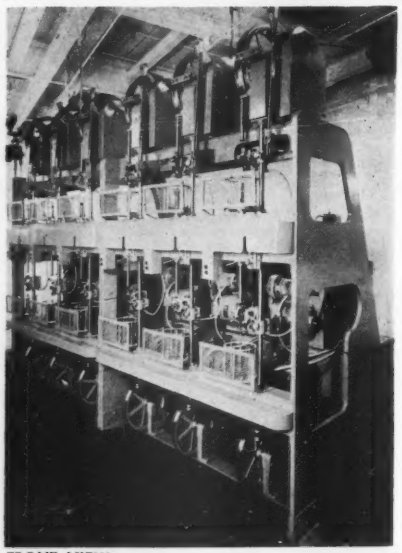
Mr. Arndt, has had wide experience in all phases of sales and engineering in the process equipment field, as well as being in charge of Heil's New York office prior to Mr. Veit's appointment. He received his chemical engineering degree from Pratt Institute and his M. S. degree form Stevens Institute of Technology.

★ ★ ★

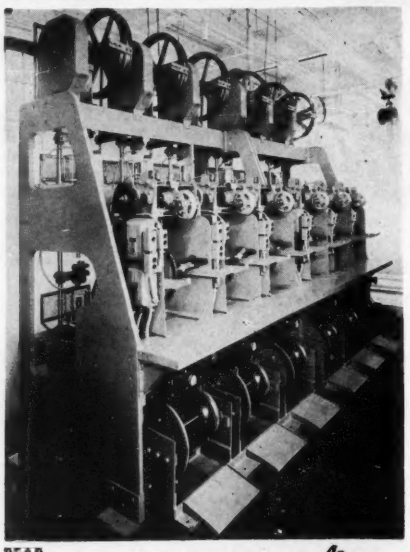
Mr. Veit, formerly was associated with Grumman Aircraft Engineering Corporation as a process engineer. He is also well-known throughout the plating industry.

## Goss Retires from Scovill

Directors of **Scovill Manufacturing Company** have accepted with sincere regret the resignation of **John B. Goss** as assistant secretary. This action was taken at

FRONT VIEW



REAR

**3D-6-MBB TAPING MACHINE #1107**

Applies double cover to 6 lines of wire simultaneously. Nominal wire range #6 to #18 B & S gauges (.162" to .040" or 4.116 MM to 1.024 MM). Standard Capstans 24" in diameter. Supply wire let-offs and torque motor driven take-ups for 24" diameter reels are at rear of machine.

*Our Centennial Year*

EST. 1855 AIMCO INC. 1915

"American" AIMCO INSULATING MACHINERY COMPANY

REG. U.S. PAT. OFF.

FAIRHILL AND HUNTINGDON STREETS

PHILADELPHIA 33 PENNSYLVANIA U.S.A.

the recent regular monthly meeting of the Board, it was announced by **L. P. Sperry,** president.

★ ★ ★

**Mr.** Goss started work with the company on September 24, 1928, and became the first to be enrolled in the advanced training course. He was elected assistant secretary at the annual meeting in 1947, but has been on sick leave for the past two years. He is a son of the late **John H. Goss,** who was president of the company from 1938 to 1944.

### Crescent Appoints Sales Manager

**Kenneth R. MacLean** was recently appointed General Sales Manager of **The Crescent Company, Inc.,** a subsidiary of the Penn-Texas Corporation, of Pawtucket, Rhode Island, manufacturers of insulated wire and cable.

★ ★ ★

**Mr.** MacLean joined The Crescent organization in 1950 in the capacity of Field Sales Manager of the Automotive Division. In 1952 he was made Sales Manager of this division. For the past year he has been active in the organization of a new industrial sales force selling the company's products in the electrical manufacturing and wholesaling fields.

★ ★ ★

**Mr.** MacLean was born and raised in the Providence area and is active in local affairs. Prior to his association with Crescent, he was employed by the General Motors Corp. and by the Anderson Company. He served with the U. S. Army as an Infantry Captain in World War II.

### Kerite Company Names Chairman

Directors of **Kerite-Company,** Seymour, Conn., have announced the election of **C. R. R. Harris** to chairmanship of the board and as chief executive officer. **Theodore O. Rudd,** vice president and director since 1946, has been elected president of the firm, which observed its centennial in the industrial fields of Connecticut earlier this year. The company manufactures insulated wires and cables.

★ ★ ★

**Mr.** Harris became associated with Kerite in 1917. He previously had been identified with Western Electric Company and Western Union Telegraph. He has been president and treasurer of Kerite since 1943. He will retain the post of treasurer in addition to his duties as board chairman.

★ ★ ★

**President** Rudd is a graduate of Yale University. After two years of service as a cadet engineer with the Philadelphia Electric Company he joined Kerite in 1926 as a sales engineer. He became vice president in 1945 and a director in 1946.

★ ★ ★

**The** Kerite Company founded in 1854 has sales offices in Chicago, San Francisco, Los Angeles and Boston. Its executive offices are at 30 Church Street, New York City.


**MASON lightweight, non-returnable, lithographed spools for:**

INSULATED WIRE
AUTOMOTIVE CABLE
THERMO-COUPLE WIRE
TV LEAD-IN WIRE
SOLDER WIRE

IF you want dependable performance and attractive appearance—at a low, low cost—put Mason Spools at the top of your list!

Over 175 leading manufacturers can attest to the performance of Mason Spools. As for appearance... the rich, colorful perfection of Mason lithography is your best assurance of *instant brand identification.*

Mason Spools are available in 5", 6½", 8½", and 10½" head sizes. All sizes available with 1⅞" (Dia.) barrels. The 10½" head size is available with a 3½" (Dia.) barrel. Barrel lengths from ⅝" to 14".

**Let us know about your spool requirements now! Telephone East Providence 1-2810 or write to the address below.**

**MASON CAN COMPANY**

**1949 Dexter Road, E. Providence 14, R. I.**

**Branch Plant — Greenville, Ohio**

## Appointments Announced by Cleveland Crane and Engineering

**To** complete the integration of engineering activities at **The Cleveland Crane & Engineering Co.**, Wickliffe, Ohio, **Roy Dehn**, Director of Engineering, has announced that **Harry Cotesworth** has been advanced to Chief Engineer of the Development Department, and **Kurt R. Weise** will hold the position of Chief Engineer of the Cleveland Tramrail Division.

★ ★ ★

**Mr. Cotesworth** has been with Cleveland Crane for twenty-five years and is responsible for many improvements made on cranes and tramrail equipment. Mr. Weise has been with the company thirty-one years and is widely known in the materials handling equipment field.

## Catalytic Combustion Appoints District Manager

**Ted Grimac** has been appointed District Manager for **Catalytic Combustion Corporation**, Detroit, 8, Mich., to render field engineering and sales service in Eastern Pennsylvania and Southern New Jersey. Mr. Grimac has had many years of experience in handling air corrective problems and in his new position he is available to assist industry on fume and odor disposal from waste gases, including facilities for profitable heat recovery from such gases. He will be pleased to demonstrate how gases containing organic contaminants, carbon monoxide, hydrogen, sulphur, etc. may be reduced to harmless end-products when subjected to the spontaneous oxidizing action of Catalytic Combustion's ruggedly built all-metal platinum alloy catalysts.

## To Head Swift's Soap Department

**G. H. Hallenbeck**, has been named head of **Swift & Company's** soap department, it announced recently by company vice president **E. A. Moss.**

★ ★ ★

**Mr.** Hallenbeck succeeds **M. L. Westering,** 9807 S. Winchester Ave., soap department manager for the past 14 years, who has been assigned specialized duties in the office of Swift executive vice president, **O. E. Jones.**

★ ★ ★

**Mr.** Hallenbeck joined Swift in 1933. In 1937, he was transferred to the branch house sales division, where he spent the next several years traveling among company units.

★ ★ ★

**He** joined the soap department in 1947, where he headed the industrial soap division prior to his appointment as manager.

★ ★ ★

**Mr. Westering,** a 32-year veteran with Swift, joined the Company at North Portland, Ore., in 1922. In 1931 he was promoted to assistant plant sales manager, and in 1935 was transferred to South St. Paul, Minn., in the same capacity.

★ ★ ★


CAMDEN WIRE CO., INC.

*Wire Fabricators*

BARE OR TINNED COPPER WIRE AND STRAND

GALVANIZED STEEL WIRE AND WIRE ROPE

40 Masonic Avenue • Camden, New York

**Transferred** to Chicago in 1936 as a member of the general plant sales department, Mr. Westering was appointed assistant head of the general soap department in 1939. He has been head of that department since 1941, supervising production, distribution and sales of all types of Swift soaps and cleansers.

### For the Ladies at the New York Regional Meeting

**Provision** has been made for the ladies who accompany their menfolk to New York for the New York area Regional Meeting on April 28th and 29th, that promises to be a good and interesting time for them.

★ ★ ★

A special desk will be set up at which the ladies may secure tickets or make arrangements to do the things that will most interest them. This desk will be in charge of a representative of the New York Tourist Bureau. Features will include: Shopping tours, Broadway plays, baseball games, TV Broadcasts, Radio City tours, United Nations tours, world-famous museums, the Planetarium, Coney Island, Carnegie Hall concerts, the best restaurants and night clubs, Chinatown and the Statue of Liberty.

★ ★ ★

**Whatever** SHE likes, she will find the opportunity to do among these interesting trips that can be arranged. The men will be able to make a long weekend of the New York meeting and join the ladies on some of these tours.

### Carpenter Webb Wire Appoints Midwestern Sales Head

**Delwyn A. Marquette** has been placed in charge of sales in the midwest by the **Webb Wire Division** of **The Carpenter Steel Company**, New Brunswick, N. J.

★ ★ ★

**He** will be located in Chicago, and will represent the company in Illinois, Wisconsin, Missouri, Michigan, Indiana, Ohio and western Pennsylvania.

★ ★ ★

**Before** joining Webb, Marquette was a member of the sales force of Remington Rand, Inc., in Chicago. He is a graduate of Chicago's Loyola University.

### International Paper Appoints Sales Executives

**A. S. Bear** has been appointed to the new position of Manager of Eastern Sales of the Container Division, **International Paper Company**, it was announced recently by **Arthur B. Damon**, General Manager.

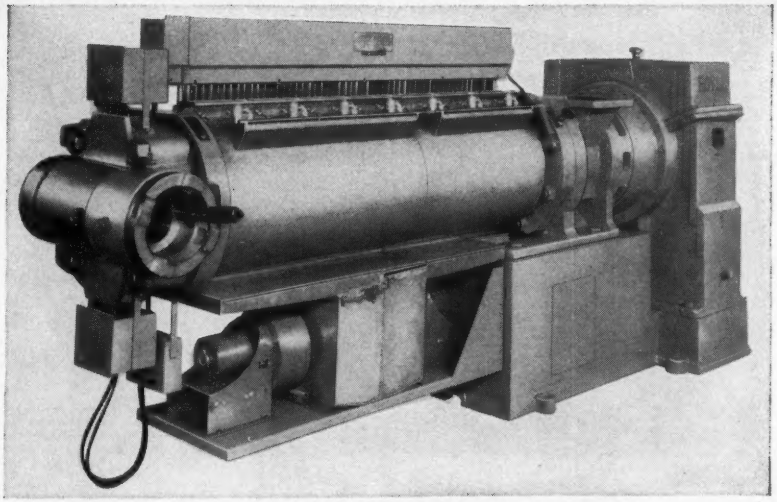
★ ★ ★

**In** his new position, Mr. Bear, who has been with International Paper since 1939, will supervise sales activities for the company's Eastern corrugated shipping container plants at Georgetown, S. C.; Whippany, N. J.; Somerville, Mass.; Manchester, N. H., and Geneva, N. Y.

★ ★ ★

**At** the same time, Mr. Damon announced that **R. E. Oas** has been


THE ROYLE ALL • ELECTRIC SPIROD



The latest addition to the Royle line, these all-electric Spirod extruders are built to supply — and hold — the higher and accurately zoned operating temperatures that are essential to present extrusion processes. This outstanding performance is only possible with the inclusion of a proportioning controlled system of high velocity evaporative cooling combined with tubular resistance heating — just one of the many features that assure economical, dependable production.

**Available in standard sizes 1⅛" through 12"**

No. 5 8½" ROYLE EXTRUDER for applying plastic insulation to cable up to 4½" diameter.

JOHN ROYLE & SONS

ROYLE PATERSON N. J. 1880

PIONEERED THE CONTINUOUS EXTRUSION PROCESS IN

London, England — James Day (Machinery) Ltd. — Hyde Park 2430 - 0456

Home Office — V. M. Hovey J. W. VanRiper — SHerwood 2-8262

Akron, Ohio — J. C. Clinefelter — SWandale 4-5020

Los Angeles, Cal. — H. M. Royal, Inc. — LOgan 3261

PATERSON 3, NEW JERSEY

appointed Sales Manager of the Whippany Container Plant. Mr. Oas has been in charge of the Division's National Sales Accounts since 1953.

### Ajax Electric's New President

**John E. Haig,** recently elected president of the **Ajax Electric Company,** Philadelphia, Pa., has had over forty years experience in the furnace business. For five years he was engaged in experiments, under the direction of **Dr. G. H. Clamer,** on brass melting electric furnaces which culminated in the development of the Ajax-Wyatt furnace. For four years more he worked on the further improvement and production of this furnace. For twelve years prior to that he was connected with various furnace companies on the design of heat treating furnaces. One of the founders of the Ajax Electric Company twenty-four years ago, he has since been principally responsible for everything in connection with the design, manufacture and sale of electrically heated salt bath furnaces from laying bricks to collecting unpaid bills. He served as the company's first Secretary, was later made Vice President. In November of 1954, he was elected its President.

John E. Haig, President
Ajax Electric Company

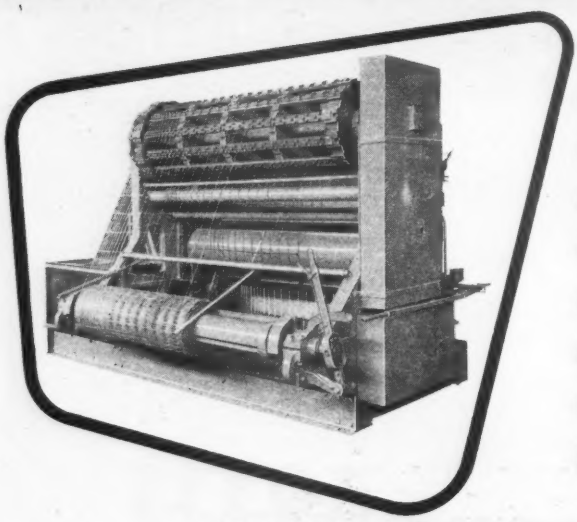
### New Sales Managers Announced by Chemical Products

**On** January 3, 1955, **William I. McGowan,** President of Chemical Products Corporation, King Philip Road, East Providence, Rhode Island, designated **Clinton M. Anderson,** Sales Manager of the Textile and Novelty Coatings Division of Chemical Products Corporation; **Gilbert C. Watson,** Assistant Sales Manager of the Novelty Coating Division; **Joseph S. Hawes,** Sales Manager of the Cable Coating Division; and **Hugh B. Allison,** Sales Manager of the Chem-o-Sol Division of Chemical Products Corporation.

* * *

All of the divisions were previously under direct supervision of the President, but the growth of all divisions has been so substantial that it was deemed wise to break down sales classification into the departments as listed above; however, all sales department heads will report directly to Mr.


Interlocking FENCE LOOMS



- Fastest — Most Efficient
- Preferred by Leading Mills
- Low Maintenance Cost
- Wrapped Stay Fence
- Straight Stay Wires
- Integrated — Space Saving
- Replaceable Main Bearings
- Single or Double Strands
- Years of Low Cost Production

**Write for Detailed Information — Without Obligation**

**Interlocking Fence Co., Box 8, Morton, Ill.**

***Specialists In Fence Looms***

McGowan. It is believed that under these new organizations, our customers' interest will be best served in our rapidly expanding sales program.

### Made Chief Engineer of Republic Unit

**Appointment** of **Gerald M. Hatch** as chief engineer for **Republic Steel Corporation's Union Drawn Steel Division** has been announced by **D. D. Buchanan,** manager of operations. He succeeds **Walter L. Brough,** who has resigned.

★ ★ ★

**Mr.** Hatch will supervise engineering activity at Union Drawn plants in Massillon, Beaver Falls, Pa., East Hartford, Conn., Gary, Ind., Los Angeles, Calif. and at a Republic subsidiary in Hamilton, Ontario, Union Drawn Steel Co., Ltd.

★ ★ ★

**He** was graduated from McKinley High School in Canton, O. and attended Ohio State University Engineering School and studied mechanical engineering at the University of Akron. He joined Union Drawn in 1937 as a draftsman in the engineering department.

### R. H. Miller To Play Host To Wire Men In New York

**At** the New York Area Regional Meeting of **The Wire Association** in New York on April 28 and 29th, the **R. H. Miller Company** of Hom er, N. Y., wire drawing lubricant manufacturers, has very kindly consented to entertain the people who attend this meeting during the hour preceding the banquet on Thursday Evening, April 28th.

★ ★ ★

**The** Miller cocktail parties have become something of a tradition at many of our meetings and this affair can be looked forward to as typical of the delightful occasions for which Van Miller, the company's genial president, is famous.

### Elects Two Officers

**Alloy Rods, Inc.,** York, Pa., has announced the election of two vice presidents.

★ ★ ★

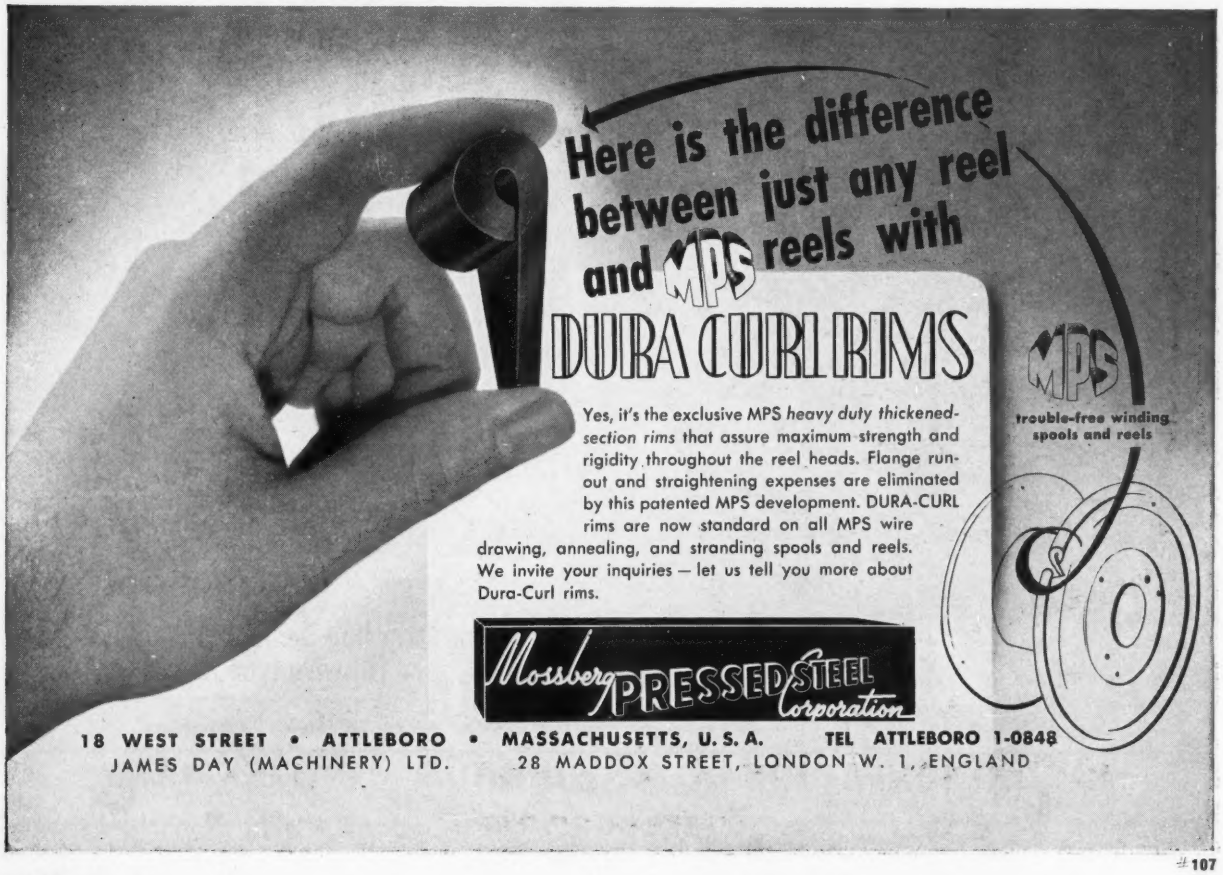
**George M. Homann** has been made vice president in charge of production and **E. R. Walsh III** has been appointed vice president in charge of sales.

### Made Plant Manager

**Paul E. Grube** has been appointed plant manager of the **Columbia Steel & Shafting Co.,** Pittsburgh, and **H. B. Reno, Jr.** appointed purchasing agent.

### John Earl Grady

**John Earl Grady,** a superintendent with the **Steel Company of Canada,** Hamilton, Ont., died January 18. He was 69. Born in Alberta, Mr. Grady was a resident of Hamilton for the past 40 years.



Here is the difference between just any reel and MPS reels with
DURA CURL RIMS
Yes, it's the exclusive MPS heavy duty thickened-section rims that assure maximum strength and rigidity throughout the reel heads. Flange run-out and straightening expenses are eliminated by this patented MPS development. DURA-CURL rims are now standard on all MPS wire drawing, annealing, and stranding spools and reels. We invite your inquiries — let us tell you more about Dura-Curl rims.
MPS
trouble-free winding spools and reels
Mossberg PRESSED STEEL Corporation
18 WEST STREET • ATTLEBORO • MASSACHUSETTS, U. S. A. TEL ATTLEBORO 1-0848
JAMES DAY (MACHINERY) LTD. 28 MADDOX STREET, LONDON W. 1, ENGLAND
#107

# A Review of Recent Wire Patents

No. 2,698,650, ZIGZAG SPRING UNIT HAVING OPEN SUPPORTING END, patented January 4, 1955 by Hyland C. Flint, Birmingham, Mich., assignor to American Metal Products Company, Detroit, Mich., a corporation of Michigan.

A seat spring is disclosed in which sinuous springs support the front intermediate and rear portions of a sinuous spring web.

★ ★ ★

No. 2,698,651, ZIGZAG SPRING UNIT HAVING CLOSED SUPPORTING END, patented January 4, 1955 by Hyland C. Flint, Birmingham, Mich., assignor to American Metal Products Company, Detroit, Mich., a corporation of Michigan.

This patent is for a single spring unit embodying a strip made of wire bent back and forth and providing lateral portions, end portions, a central arched web section and intermediate straight sections beneath the web section.

★ ★ ★

No. 2,698,812, METAL DEPOSITION PROCESS, patented January 4, 1955 by Hermann Schladiz, Munich, Germany.

There is disclosed a process of depositing a uniform firmly adherent coating of metallic particles of finely divided sub-crystalline size upon the surface of a base material such as iron. There are 22 claims.

★ ★ ★

No. 2,699,017, APPARATUS FOR LAPPING WIRE-DRAWING DIES, patented January 11, 1955 by Earl W. Johnston, Worcester, Mass., assignor to United States Steel Corporation, a corporation of New Jersey.

The construction includes a vertical spindle for rotation and reciprocation, a die holder support, carrying a die-holder mounted on a frame, with die-holder mounted for rotation about a vertical axis. There is also a member rotatable on the frame in a position such that it will engage the support and oscillate it periodically through a predetermined angle to move the die-holder between an upper horizontal position and a lower inclined position, a cylindrical pin extending downwardly from the spindle for engagement by a die in the holder as the holder moves toward this upper position, lifting means mounted on the frame and cooperating with the spindle, effective when actuated to raise it to a position in which the pin is out of contact with the die when the die holder is in upper position, a control device adjacent the spindle for the lifting means, and a flange on the spindle engaging the control device when the spindle descends on passage of the pin through the die.

No. 2,699,062, FORCE RESPONSIVE SPRING DEVICE, patented January 11, 1955 by Rudolf Karl Anton Tomaschek, London, England, assignor to Anglo-Iranian Oil Company, Limited, London, England, a British joint-stock corporation.

A coiled wire spring is provided the coils being of diminishing radius and of specific cross sectional width and thickness. There are seven claims.

★ ★ ★

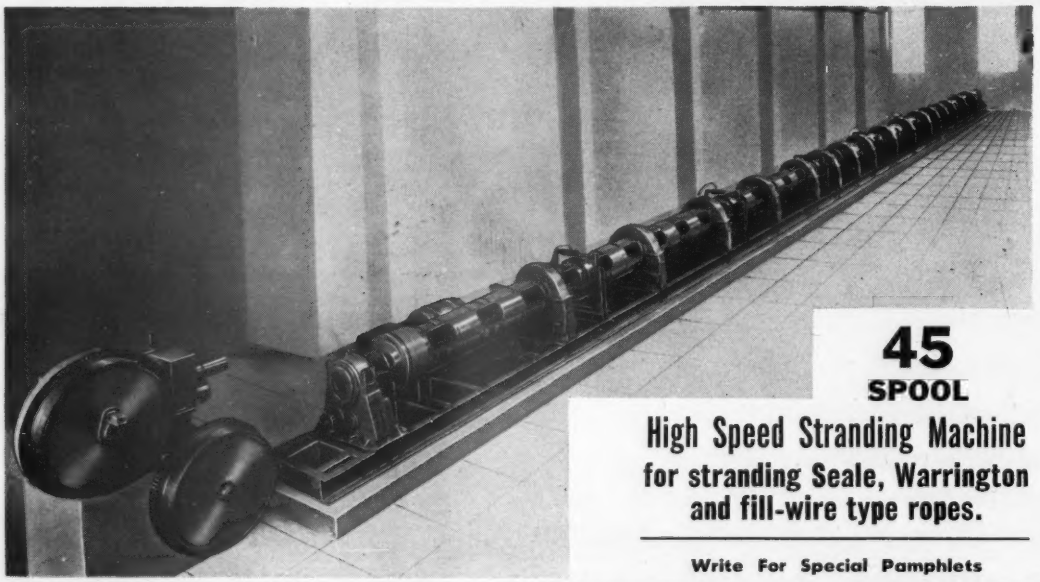
No. 2,699,297, COIL WINDING MACHINE, patented January 11, 1955 by Sol Weinrich, Rockville Centre, and Milton Newman, New York, N. Y.

A take-off arrangement is disclosed having pivoted arms for holding a wound mandrel in parallel and linear alignment with a spindle so that another mandrel may be inserted and wires lined up and taped thereto quickly and accurately. There is provision permitting the insertion of an alternate mandrel over wires extending from a first mandrel and into position between the spindle and a tailstock.

★ ★ ★

No. 2,699,308, TREE HOLDER, patented January 11, 1955 by Arthur H. Shackelford, Riverside, Calif., assignor


NIEHAUS WIRE STRANDING ROPE CLOSING CABLE MAKING MACHINES



45 SPOOL

High Speed Stranding Machine for stranding Seale, Warrington and fill-wire type ropes.

Write For Special Pamphlets

MASCHINENFABRIK K. A. NIEHAUS · GERMANY

DÜSSELDORF-RATH

to Robert L. Bidwell, San Francisco, Calif.

This is a Christmas tree stand consisting of a number of wire lengths forming legs and two supports.

★ ★ ★

No. 2,699,625, FISHHOOK EXTRACTOR, patented January 18, 1955 by David A. Craig, Lansing, Mich.

An elongated wire body is included in this extractor arrangement.

★ ★ ★

No. 2,699,790, SPRING CLIP OR BOBBY PIN AND THE LIKE, patented January 18, 1955 by Ronald Leslie Porteous, Mount Victoria, New South Wales, Australia.

The pin consists of a single length of spring metal bent to form a loop at one end and two legs which normally lie one above the other, each leg being provided with an outwardly projecting bow substantially at right angles to the plane of the loop at a point towards the loop end of the clip.

★ ★ ★

No. 2,699,803, BLASTING MAT, patented January 18, 1955 by Joseph S. Mazzella, New York, N. Y.

A woven blasting mat, rectangular in outline is provided, comprising a single length of flexible wire having two-stranded woofs, the ends of each of said two strands being joined by a bight at one edge of the mat, the opposite end of each of these strands being joined at the opposite edge of the mat by a bight with the adjacent strand of the next successive woof, the warps of the mat comprising partly two-stranded warps and partly single stranded warps.

★ ★ ★

No. 2,699,864, WIRE-DRAWING MACHINE, patented January 18, 1955 by John H. Hitchcock, Worcester, and Edmund S. Murrah, Shrewsbury, Mass., assignors to Morgan Construction Company, Worcester, Mass., a corporation of Massachusetts.

More specifically a new driving and control apparatus is disclosed for a wire-drawing machine for continuous drawing.

★ ★ ★

No. 2,699,902, COIL WINDING MACHINE, patented January 18, 1955 by Otto Wirth, Zurich, Switzerland, assignor to Micafil A.-G., Zurich-Alstetten, Switzerland.

A machine for winding fine wire on small closed ring cores is disclosed, of the type including a circularly bent and radially split tube within which the winding wire is stored.

★ ★ ★

No. 2,700,212, ELECTRICAL CONDUCTOR, patented January 25, 1955 by Edward J. Flynn and Gerald W. Young, Schenectady, N. Y., assignors to General Electric Company, a corporation of New York.

It is stated that this wire conductor has especially good abrasion resistance and consists of a core of copper having an outer surface of anodized aluminum and an outer sheath comprising polymeric chlorotrifluoroethylene superimposed on the core and in direct contact with the anodized aluminum surface.

★ ★ ★

No. 2,700,409, BENDING MEANS FOR SINUOUS SPRING STRIPS, PATENTED January 25, 1955 by Oscar Weiss, Detroit, Mich., assignor, by mesne assignments, to No-Sag Spring Company, a corporation of Michigan.

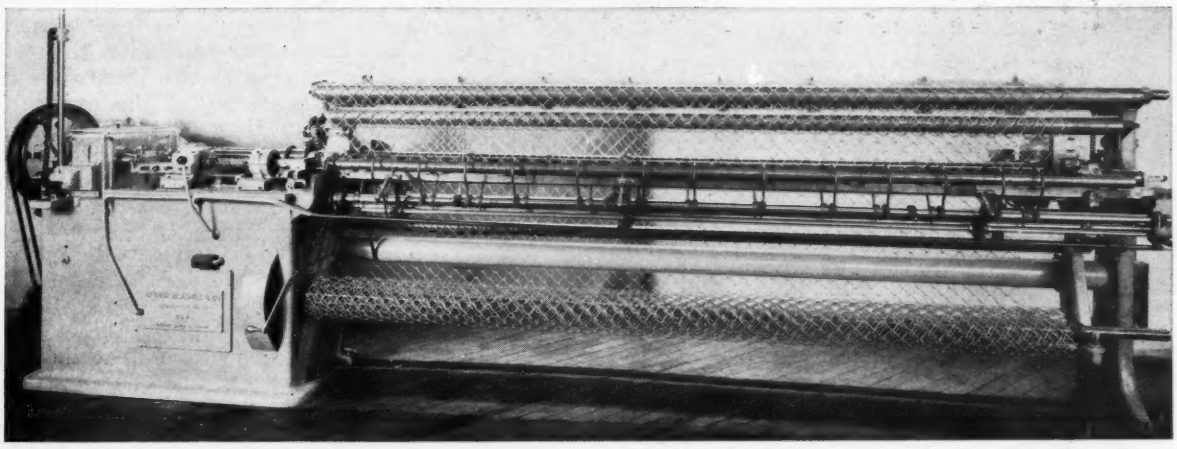
More specifically, the machine is for reforming the longitudinal arch in wire springs of the type having a number of sinuous turns and a longitudinal arch.

★ ★ ★

No. 2,700,514, APPARATUS FOR COILING WIRE, patented January 25,

**The information in this section is furnished by the patent law offices of LANCASTER, ALLWINE & ROMMEL, 438 Bowen Bldg., Washington 5, D. C. Data listed is only a brief review of recently issued patents obtained by various U. S. Pat. Off. registered attorney for manufacturers and/or inventors. Complete copies may be obtained direct from Lancaster, Allwine & Rommel by sending 50¢ for each patent desired. Outside of the U. S. and Canada the cost is $1.00 for each copy.**


# INVINCIBLE CHAIN-LINK FENCE MACHINE



**Does a fast and Beautiful Job and "Pays for itself" with the wire saved.**

**ARTHUR BLASHILL & COMPANY**

**78 DOWNING STREET**

**WORCESTER 10, MASSACHUSETTS, U.S.A.**

1955 by Gordon R. Whittum, Auburn, Mass., assignor to United States Steel Corporation, a corporation of New Jersey.

The construction includes a frame block rotatably mounted on a shaft adjacent the end thereof remote from its wire entry end, the end of the shaft remote from the entry end projecting coaxially into the frame block, a device mounted on the shaft and rotatable therewith for winding the filament on the frame block, an armature shaft projecting outwardly of the housing, the projecting end of the armature shaft being fixedly connected with the frame block, and a device connecting the electrical motion transmitting device with the receiver whereby the armature is rotated at the same speed as the shaft but in the opposite direction thereto.

## Jelliff Appoints Michigan Agency

**The C. O. Jelliff Manufacturing Corp.,** Southport, Conn., announced that it has appointed as sales agents for the whole state of Michigan, plus metropolitan Toledo, Ohio, The Carl H. Schmidt Company, 2405 West McNichols Road, Detroit 21, Michigan.

★ ★ ★

**The** Schmidt organization will handle Jelliff's extensive line of alloy resistance wires, which are widely used in wire-wound precision electrical and electronic components, heating elements of appliances and furnaces, and so on.

★ ★ ★

**The** Jelliff Company is celebrating its 75th anniversary in 1955. Established in Southport in 1880 to weave flour sieves of horsehair for local farmers, it has grown through the years to be one of the leading manufacturers of fine-gage electrical resistance wires and fine mesh wire cloth. Jelliff received special commendation for its part in the development of materials for the atom bomb project during the late war.

## New Service Drop Cable Eliminates Tree Trimming

A new type of service drop cable designed especially to withstand the abrasive wear and cutting action of tree limbs has been developed by the **Rome Cable Corporation,** called TreePlex.

★ ★ ★

**To** the already tough polyethylene insulation covering each power conductor, has been added a tight, thin (.005″) sheath of Nylon. This compound has been heat and light-stabilized for extra-long weather resistance.

★ ★ ★

**Laboratory** tests show that this Nylon sheath has increased the wear resistance of the new cable by more than 50 times, as compared with standard Triplex service drop cable. This greatly increased capacity to withstand abrasion and impact makes it possible to install TreePlex directly through heavy trees.

★ ★ ★

**Rome's** new cable is available in duplex, triplex and quadrex types. It can be obtained with coppor or aluminum power conductors spiralled around neutral messengers of copper, Copperweld, ACSR or aluminum. On special orders it also can be supplied with a polyethylene-covered Weatherproof Wire as the neutral conductor.

★ ★ ★

**Additional** information can be obtained from Rome Cable Corporation, Rome, N. Y.

Ends and traverses may be shipped separately and assembled easily in your plant on a hand, foot, or power press.
5″ and 6-1/2″ diameter ends with 1-15/16″ diameter traverses.
10-1/2″ diameter ends with 3-1/2″ diameter traverses.
Traverse lengths up to 12″

J. L. Clark
LITHOGRAPHED METAL CONTAINERS

J. L. CLARK MANUFACTURING COMPANY • ROCKFORD, ILL.

## General Cable Installing Extruder for Aluminum Sheathed Cable

**Completed** construction of the **General Cable Corporation's** new press, which will be the first in the United States for the production of direct-extruded aluminum sheathed cables, will be in February, 1955, **Irving T. Bennett,** chairman of the board and chief executive officer, and **J. R. MacDonald,** president, have announced.

★ ★ ★

**Construction** of the new press by **Schloemann** of Dusseldorf, West Germany, is now well along.

★ ★ ★

**The** new press will be delivered in mid 1955 and installed in the Perth Amboy, New Jersey, plant of General Cable Corporation. Representatives of Schloemann will supervise installation of the press and the start of its operation.

★ ★ ★

**Particular** interest has been shown in the fact that aluminum sheathing is lower in cost per unit volume than conventional cable sheathing, that it is lighter in weight and has greater mechanical strength. There has been indication also that the direct extrusion of aluminum is a good method of sheathing cable.

★ ★ ★

**General** Cable Corporation will move just as fast as possible to enable American industry to take advantage of the superiority of direct-extruded aluminum cable sheathing.

## New Hi-Speed Gear Unit

**The Philadelphia Gear Works, Inc.,** Erie Ave. & G St., Philadelphia 34, Pa., has developed a completely new and improved line of Hi-Speed Gear Units for speed reduction and increased service. These standardized units have been designed to operate above the speed range of ordinary reducers. Rotating speeds up to 9000 RPM and pitch line velocities to 10,000 feet per minute can be accommodated without modification.

★ ★ ★

**These** Gear Units are finding wide acceptance in service with turbine drives, test stand drives and air conditioning applications. These units are manufactured in 17 sizes for ratings up to 7100 HP and are available in any specified ratio from 1:1 up to 10:1.

★ ★ ★

**Rugged** housings include ample oil reservoir, integral pump and coolant system with spray nozzles directed at the line of gear contact. Bearings are of the babbitted bronze type, centrifugally cast for uniformity of grain structure.

★ ★ ★

**For** further information on these new Hi-Speed Units, write for catalog HI-542.

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WIRE AND WIRE PRODUCTS
It pays—send for rates
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**Refinishing Wire Drawing Dies?**

**Save Money with NORBIDE® Abrasive . . .**

Second in hardness only to diamond which costs a hundred times more

Johnson Steel & Wire Co., Inc. has substantially reduced the cost of refinishing their wire drawing dies by substituting NORBIDE Abrasive for costly diamond dust. Excellent for ripping or for fast stock removal as well as for accurate semi-finishing operations.

High accuracy is important to Johnson for Johnson "music" spring wire is drawn in 200 different sizes, all the way from .003" to .200".

If you are still using diamond dust for your ripping and semi-finishing operations, you'll be amazed at the savings you can obtain by switching to NORBIDE Abrasive.

For cost-cutting abrasive details, write for Form 559.

NORTON COMPANY
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NORTON
BORON CARBIDE

**NORBIDE® . . . the hardest man-made abrasive**

## New Tentative Specifications for Nickel and Nickel-Base Alloy Covered Welding Electrodes

**For** the first time, industry wide specifications have been agreed upon for nickel and nickel-base alloy covered welding electrodes. These new Tentative Specifications, issued jointly by the **American Society for Testing Materials** and the **American Welding Society** (ASTM Designation B 295; AWS Designation A 511) cover electrodes for welding nickel and nickel-base alloys individually to themselves and also for welding these materials to steel. Also included are filler metals for welding the clad side of nickel-base alloy clad steels.

★ ★ ★

**Twelve** classifications of filler metal are established by these specifications including all the commonly used materials. This involves, among others, Nickel, Monel, K Monel, Inconel, Inconel X, as well as various Hastelloy alloys.

★ ★ ★

**An** Appendix is included as an aid to users in selecting the most suitable filler metal for their needs. It contains information on the use of each classification for joining different base metals with the shielded metal-arc welding process.

★ ★ ★

**Copies** of the Specifications can be obtained at 25 cents each from the American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa.

## New Booklet Covers High Speed Blanking Presses

**A** new, 8-page, file size booklet published by the Press Division of **Waterbury Farrel Foundry & Machine Co.**, Waterbury 20, Conn. presents detailed information on WF blanking presses having a 300 to 900 rpm. range.

★ ★ ★

**The** bulletin covers two sizes of blankers, designated No. 0 and No. 1 which are used for mass production of parts requiring blanking, piercing, shallow drawing and forming. Several illustrations show the units from various angles, give close-ups of design details and picture some typical production samples. Features such as the two post gate guides, connection design, etc. are described, together with the feed arrangement, drive, tooling and accessories.

★ ★ ★

**Dimension** drawings coupled with a specification table provide complete capacity and dimensional details for both sizes of WF blankers as well as for a dovetail plate, capped plate and a punch plate.

★ ★ ★

**The** bulletin also lists a few of the other types of machinery built by the Power Press Division and other Waterbury Farrel Divisions.

★ ★ ★

**Free** copies of this new booklet are available on request from Waterbury Farrel Foundry & Machine Co., Waterbury, Conn. Ask for circular No. 915—N-2.

It will pay you
to get samples of
PLYMKRAFT
IMPROVED CABLE FILLER
To keep up to date on cable filler developments, it takes only an inquiry for samples of PlymKraft. This improved type of twisted paper is available in the exact put up that works best on your equipment, with any type of treatment applied—wax, jute saturant, antracene.
It is made to fine tolerance, always uniform, and backed by the Plymouth Cordage Company, known as the makers of top quality products since 1824.

**Write to:**

**PLYMOUTH CORDAGE COMPANY**

**Plymouth, Massachusetts**

## Completes 46th Year of Electric Furnace Steel Melting

**Firth Sterling, Inc.** was the first company to foresee the value of the Electric Steel Melting Furnace, an innovation in 1906 and a vital part of steel-making progress today. The furnace was ordered in 1906 but was not delivered until early in 1908. The frame of this original furnace was made of bronze, later replaced by steel. Experience also altered the arrangement of the graphite electrodes, moving them from a straight-line position to placement in an equilateral triangle. Even the rectangular shape of the first electric furnace has given way to a round shape. Although furnaces of this kind which are currently being made have capacities of up to 200 tons, Firth Sterling's pioneer work began humbly with a furnace which had a capacity of only 2¾ tons. Such furnaces were first used to melt only high speed steels, but now are being used in the manufacture of all types of high quality tool steels.

★ ★ ★

**Electric** furnaces will be displacing many of the open hearth type in the near future, the reason for the popularity of electricity is that no other form of heat can be so easily concentrated, so carefully controlled and so efficiently used to give such high temperatures.

★ ★ ★

**It** is this futuristic viewpoint which inspired Firth Sterling's purchase of the first electric melting furnace 48 years ago and which has made Firth Sterling so prominent in the Metallurgical Development of High Speed Steels, Super High Speed Steels, Stainless Specialty Steels, and High Temperature Alloys.

## Battelle's New Pilot Plant Nearing Completion

**The** first units of facilities for an expanded program of pilot-plant and large-scale research for American industry are nearing completion at **Battelle Institute's** recently purchased 400-acre site just outside Columbus, Ohio.

**The** new facilities, according to **Clyde Williams,** Battelle's president and director, will be used primarily for large-scale studies in chemical engineering, metallurgy, and minerals processing.

★ ★ ★

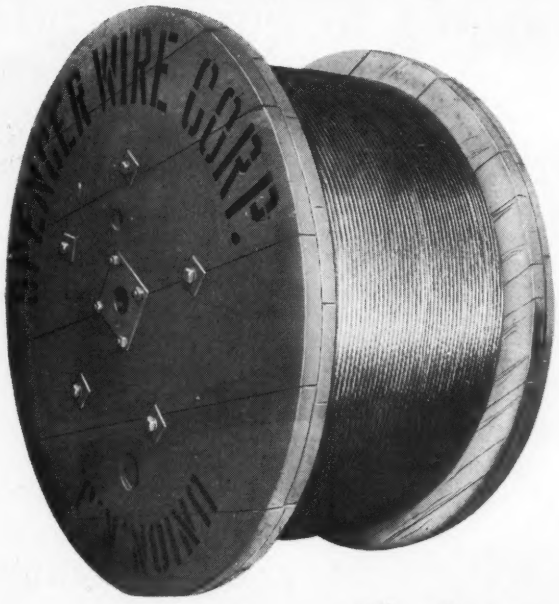
**Provided** initially in the construction program are two major buildings, totaling 13,000 square feet and designed specifically for large-scale experimental work. Ample water, natural gas, and electric power have been provided to meet any foreseeable pilot-plant need. Additional buildings are contemplated and will be custom built to fill specific industry needs as they arise.

★ ★ ★

**The** new laboratories will house extensive chemical engineering equipment. Also being installed is a 500-KVA, 3-phase transformer, equipped with automatic controls, which can be used with a 1000-pound melting furnace or for studies of continuous smelting.

★ ★ ★

**Much** of Battelle's expanded


**all sizes and constructions of high quality copper and bronze wire**

**SPENCER WIRE CORPORATION**

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Plants at UNION, N. J. Telephone: MUrdock 6-7950

pilot-plant research will be guided by **John W. Clegg,** Manager, Department of Chemical Engineering, **J. Harry Jackson,** Manager, Department of Metallurgy, and **W. H. Browne,** Manager, Department of Mechanical Engineering. All have been closely associated with the Institute's already extensive large-scale experimental studies.

## New Catalog on Carbide Blanks

**Firth-Loach Metals Inc.** of McKeesport, Pa., has just issued a 20-page, two-color catalog of its complete line of "Firlomet" cemented carbide blanks.

★ ★ ★

**The** new catalog from this newly-formed carbide producer describes all styles of standard and modified-standard blanks as well as rectangular strip, pulley grooving and stone chisel blanks; unground inserts; heading die nibs, mandrel nibs and nail die nibs; die inserts and special blanks and inserts. Prices and terms for all blanks are also shown.

★ ★ ★

**In** addition, the new brochure, Catalog No. 1, illustrates the modern carbide plant and its production and laboratory equipment. The unique Firth-Loach policy, by which it produces carbide metals only and leaves fabrication to tool and die makers, is carefully explained. Also included for convenience is a grade selection chart.

★ ★ ★

**Copies** can be obtained by writing to Firth-Loach Metals Inc., Buttermilk Hollow Road, McKeesport, Pa.

## Line of Rolling Mills, Slitters and Accessory Equipment Shown in New Brochure

A complete line of laboratory and production rolling mills, rotary gang slitters, levelers and accessory equipment is shown in a new four-page, two-color bulletin available from **Stanat Manufacturing Company,** 47-28 37th Street, Long Island City 1, N. Y. This precision equipment, although small in size, has all of the rugged features of much larger machinery and is ideally suited to both laboratory research and regular production in the metal processing industries. Featured in the Stanat line is the revolutionary 2-High/4-High Combination Mill that can be converted easily from two-to-four high operation for greater processing versatility. Valuable to all metal processors, bulletin No. 210 is available on request.

## Making Study of Heating Units for Bonding Stranded Wire

As a service to the electrical industry **William Brand & Co., Inc.,** Willimantic, Conn., is making a detailed study of the performance of newly developed induction heating units for bonding stranded wire during the cutting and stripping operations. This study is being conducted in their own plant as well as the plants of suppliers of copper conductor, users of plastic insulated wire, and a manufacturer of the induction unit.

★ ★ ★

A preliminary report giving first findings has been issued and may


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be obtained by writing to: Technical Information Department, William Brand & Co., Inc., North & Valley Sts., Willimantic. The study is continuing and it is contemplated that additional reports will be issued as more data is accumulated.

### Opens New Spring Plant in Syracuse

**Wallace Barnes Company,** 97 years old spring manufacturer, a division of the Associated Spring Corp., whose main plant is located at Bristol, Conn., has announced the opening of a new plant in Syracuse, with **Warren H. Beach** as district sales manager.

★ ★ ★

**With** 11,000 square feet of manufacturing space containing latest types of automatic equipment, the new plant enables Wallace Barnes Co. to provide closer contact and better service to meet the expanding needs of industries in the Central New York area. The plant will produce springs of the compression, extension and torsion type, and wire forms.

### Electroplating Equipment Concern Changes Name

**Enthone, Inc.,** manufacturers of chemical products for metal finishing has announced a change in the name of its division formerly known as Conn. Metalcraft, Inc. The new name will be **Comco, Inc.** This corporation has been engaged in the design and manufacture of plating racks, fixtures, filters, plastic tanks, ventilating ducts and in the sale of general equipment for the electroplating industry. The company is located at 442 Elm Street, New Haven, Conn.

### To Concentrate on Hydraulic Tools

**The Manco Mfg. Co.,** of Bradley Illinois, has announced that they are discontinuing their Manco and Carolus line of bolt cutters and steel strapping cutters. Service for present users of these tools is being taken over by the **Roberts Mfg. Co.,** of Somerville, Massachusetts.

★ ★ ★

**Manco,** long a major producer in this field, reached the decision to drop the line following a recent major fire at their Kankakee plant. The company plans to concentrate on their Guillotine line of hydraulic tools for cutting, punching, and riveting, and on the development of other specialized hydraulically operated tools and equipment.

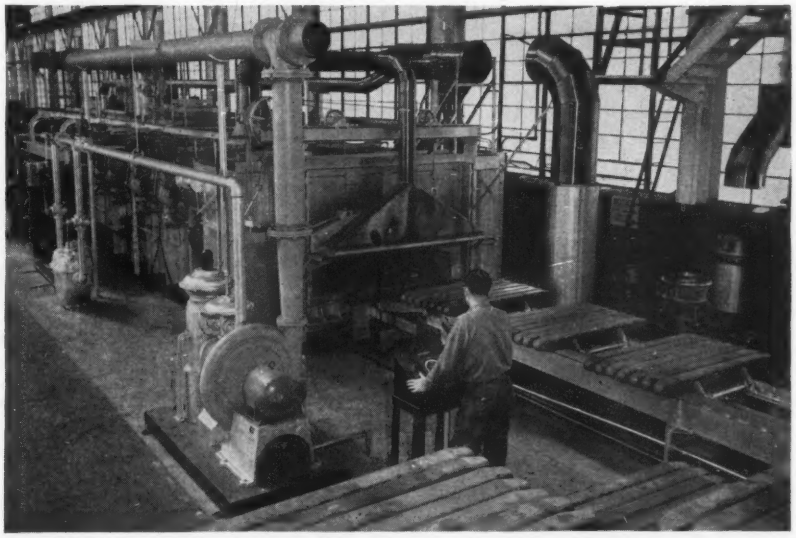
### To Distribute Harper Furnaces in Canada

**Harper Electric Furnace Corp.,** Buffalo, N. Y., manufacturer of high temperature electric furnaces and kilns, has appointed **Amco Furnace Contractors Ltd.,** Toronto, Ont., as a distributor.

### Atlantic Steel Plans Major Expansion

**The Atlantic Steel Company,** Atlanta, Ga., is presently planning a $10,000,000 expansion, to be financed partly by issuance of stock. **R. S. Lynch,** president, said that the plan calls for a new merchant bar and rod mill, a second electric furnace and a new administration building.


# The Making of Copper Wire Starts Here



## In a Rockwell Wire Bar Furnace

This continuous, chain conveyor type, gas-fired furnace heats copper wire bars and slabs scale-free up to 1650° F. Bars range in length from 30″ to 60″ and weigh up to 290 lbs. each. Heating capacity is 12,500 lbs. of copper, or an average output of fifty 250-lb. bars per hour.

Rockwell has built a large number of furnaces of various types for heat-processing steel and non-ferrous alloys from raw bar stock to finished heavy or fine wire right down to enameling, tinning or synthetic or glass-coating magnet wires.

It will pay you to learn more about Rockwell wire heating equipment. Get Bulletin 432.

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**W. S. ROCKWELL COMPANY**

FURNACES • OVENS • BURNERS • VALVES • SPECIAL MACHINERY

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## American Brass to Build Aluminum Plant

**The American Brass Company,** wholly-owned subsidiary of **Anaconda Copper Mining Company,** will soon construct an integrated aluminum mill on the outskirts of Terre Haute, Indiana, according to a joint announcement issued in January by the Anaconda president, **Robert E. Dwyer,** and **Arthur H. Quigley,** chairman of the board of The American Brass Company.

★ ★ ★

**The** Terre Haute fabricating facility will be an extension of Anaconda's already announced entry into the aluminum field. In 1953 the Anaconda Aluminum Company started construction of a new aluminum reduction plant at Columbia Falls, Montana, which will be completed about the middle of this year. Eventually, this plant will attain an annual production of 60,000 tons of ingot aluminum. The requirements of **The American Brass Company** and **Anaconda Wire & Cable Company** will be obtained from this source.

★ ★ ★

**The** new plant will be built on a 315-acre site, four miles north of Terre Haute center. As soon as the company's engineering department can complete the planning, ground will be broken for the new mill which, together with a separate office building, will cover 500,000 square feet. The main plant will be one-story, heavy steel construction with overhead crane service throughout. The new office will front on North 13th Street. Construction cost will be in the neighborhood of $25,000,000. The building program will be under the supervision of Anaconda Copper Mining Company's chief engineer, **Wilbur Jurden.**

★ ★ ★

**It** is expected that an operation of this magnitude will eventually support a working force in the neighborhood of 1,000 people, nearly all of whom will be recruited locally.

★ ★ ★

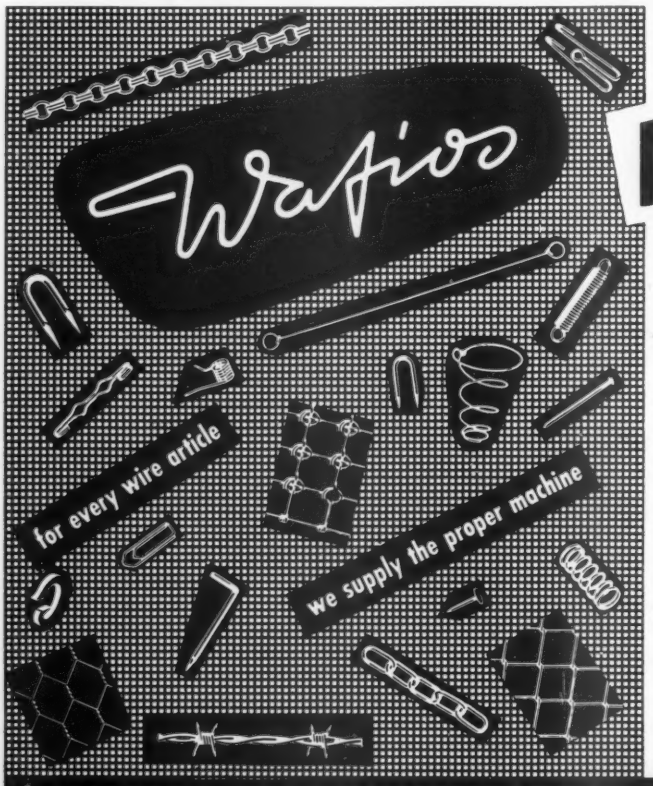
**Production** at Terre Haute will include casting of aluminum ingots and billets, rolling of sheet and strip, and extrusion of tubes, rods and special shapes.

★ ★ ★

**The** American Brass Company is one of the nation's oldest and largest fabricators of copper and copper-base alloy wrought metal products, such as sheet, rod, tube, wire, extruded shapes, and manufactured products including eyelets, stampings, and flexible metal hose and tubing. It has been a principal supplier to the electrical, automotive, building and metalworking industries for many years.

★ ★ ★

**The** Brass Company traces its beginnings back to 1812 in Waterbury, Connecticut, where its headquarters are now located. It operates 10 plants in Waterbury, Torrington and Ansonia, Conn.; Buf-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AUTOMATIC PAPER CLIP MACHINE

for the manufacture of all standard clips

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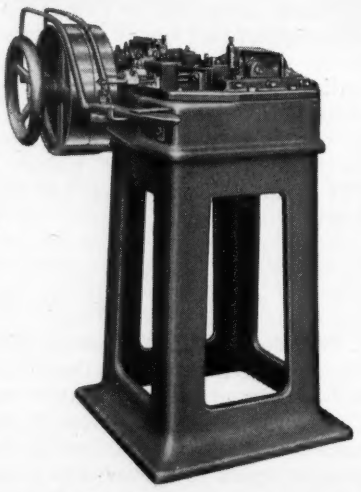


WAFIOS MASCHINENFABRIK REUTLINGEN 3 / GERMANY

falo, N. Y.; Detroit, Mich.; Kenosha, Wisconsin and New Toronto, Ontario.

★ ★ ★

**James F. Ackerman,** currently serving as vice president of The American Brass Company's Torrington, Conn. plant, will be in charge of the new aluminum fabricating operation at Terre Haute.

### Increased Rating of Varidrive

**To** provide for extra heavy-duty services where variable speeds are needed, the U. S. Varidrive motor has now been upped to 60 horsepower. Previously the top power limit was 50 horsepower. This increase in power now greatly broadens the application of variable speed. These larger capacity motors may also be equipped with remote controls, either mechanical or electrical. The 60 horsepower motors are equipped with dual varibelts of double-ribbed design which divide the transmission load so that excessive strains are avoided. Details of the new heavy-duty 60 horsepower Varidrive may be obtained from **U. S. Electrical Motors Inc.,** Box 2058, Los Angeles 54, California.

### Offers Reprints of Viscosity Conversion Chart

**A** chart which provides a quick, convenient means of translating any viscosity measurement into seven other standard units has just been released by the **Nopco Chemical Company.**

★ ★ ★

**Methods** of measuring viscosity vary from industry to industry and, even in the same field, from one company to another. This novel conversion nomograph has been designed to minimize the problems caused by the lack of standardization by providing a means of rapidly converting from one system to another.

★ ★ ★

**The** chart is available free of charge by writing to Dept. VC, Nopco Chemical Company, Harrison, N. J.

### New Shipping and Receiving Building at Cleveland Crane

**Construction** of a new $500,000 Shipping and Receiving Building has just been started at **The Cleveland Crane & Engineering Co.,** Wickliffe, Ohio, manufacturers of heavy overhead traveling cranes, overhead tramrail materials handling systems, metal-cutting tower shears, and various type heavy presses.

★ ★ ★

132 x 160 feet in size, the building will be modern in every respect and equipped with the latest handling facilities to expedite the movement of incoming materials and outgoing heavy machinery. Spur tracks from both the New York Central and Nickel Plate railroads will be run into the building. Special consideration has been given to the handling of materials on and off the hundreds of trucks which serve the plant every month so that they can leave in the fastest time possible.


*COMING . . .*

**THE WEST COAST REGIONAL MEETING OF THE WIRE ASSOCIATION**

**At the Sir Francis Drake Hotel**

**San Francisco, Cal., June 10, 1955.**

Mark this date on your calendar now. The Program Committee is now formulating a program that will be worthy of your interest and especially hopes for a good attendance of Eastern wire men, who are cordially invited to come to the Coast for this annual Wire Association meeting.

THE PROGRAM COMMITTEE

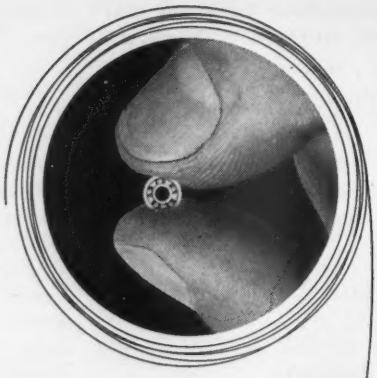
General Chairman: WILLIAM MOHR, Wire Mill Supt., California Wire Cloth Co., So. San Francisco.
Committee Members: EARL R. POTTER, Pres. and Genl. Mgr., Industrial Wire Products Corp., Los Angeles;
JOSEPH F. CONLAN, Treas., K. H. Davis Wire and Cable Corp., Los Angeles;
STERLING EDWARDS, Pres., E. H. Edwards Company, So. San Francisco.

Besides the regular features, arrangements have been concluded to visit a wire mill and wire rope manufacturing plant in the San Francisco area. There is every promise of features of interest and value to wire men.

***Full details will be given later.***

**THE WIRE ASSOCIATION**

**RICHARD E. BROWN,** ***Executive Secretary***
**453 MAIN STREET STAMFORD, CONN.**



# Draw on this fine wire experience

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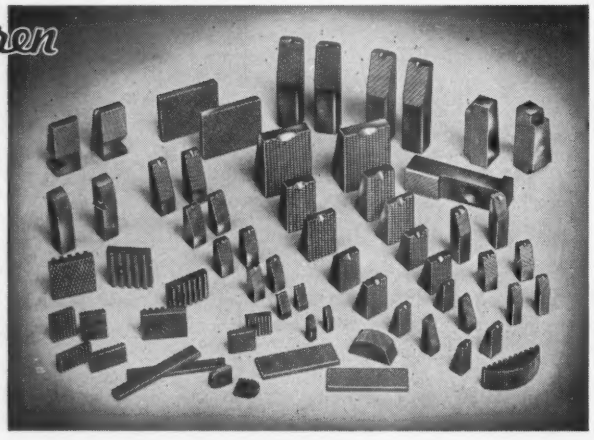

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## Stress Corrosion in High Tensile Wire

(*Continued from page* 319)

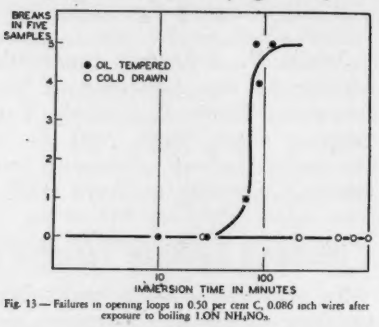


Fig. 13 — Failures in opening loops in 0.50 per cent C, 0.086 inch wires after exposure to boiling 1.0N $NH_4NO_3$.

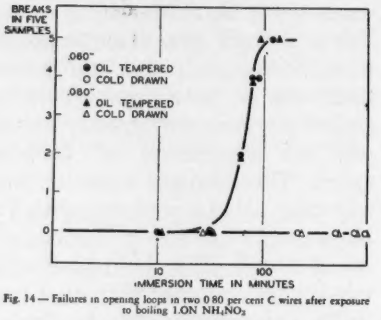


Fig. 14 — Failures in opening loops in two 0.80 per cent C wires after exposure to boiling 1.0N $NH_4NO_3$.

Free loop tests were also made in the sulphate, carbonate and chloride solutions, with the same results mentioned previously; namely, generalized corrosion but no appearance of stress corrosion failure.

### Results of Second Series of Tests Free Loop Tests

1. In contrast to some of the results of the first series of tests (static bend tests) the results of the second series using the free bend test, indicate sharply a very pronounced difference in stress corrosion sensitivity between oil tempered wire and hard drawn wire.

★ ★ ★

2. This sensitivity is not affected by carbon content within the range tested; namely, from .50 to .80 C.

★ ★ ★

3. The free loop tests confirmed the fact that of the solutions tried, only the nitrates are capable of inducing stress corrosion failures, regardless if whether the steel had derived its tensile strength from oil tempering or from the process of cold working.

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It is, of course, axiomatic that the nitrate solution will eventually produce brittle failure in all exposed free loop samples, regardless of whether they were oil tempered or hard drawn. The first series of tests proved that fact beyond doubt. However, it must be pointed out that there was a large difference in size between the samples of the two test series. Presently, we ere engaged in an investigation to determine whether or not there is an effect of size, which may be particularly pronounced in the case of the eutectoid steels. Also, we have under way concurrently duplicates of both types of tests at solution concentrations controlled at very much lower levels. In the case of the free loop tests this involves a rather large number of samples.

## Final Summary

1. **Within the limits of this investigation, high strength steel wire used as a construction material appears to be subject to stress corrosion failure only in the presence of nitrate solutions.**
2. **In nitrate solution, oil tempered wire has been proven to be substantially more sensitive to stress corrosion than wire in the hard drawn state.**
3. **Since all high strength steel wire used in prestressed concrete must be protected adequately against any type of corrosion, it follows that stress corrosion failure may be expected only in cases where such general protection breaks down.**

## Acknowledgments

**The author wishes to acknowledge with thanks the contributions made to this paper by the following members of his staff.**

**G. T. Spare, research project engineer, under whose supervision the investigation was performed, and**

**C. D. Stricker, research assistant, who did the actual work.**

## The State of Lubrication in Wire Drawing Operations

(*Continued from page* 303)

**25. A. E. Ranger & J. G. Wistreich, "Study of Lubrication in Wire-drawing by an Electrical Method", Paper presented at the Institute of Petroleum Symposium on Metal-working Oils, 19th March, 1954.**

**26. D. G. Christopherson, H. Naylor and J. Wells, "Some Observations on Conditions of Lubrication in Wire-drawing Dies", Paper presented at the Institute of Petroleum Symposium on Metal-working Oils, 19th March 1954.**

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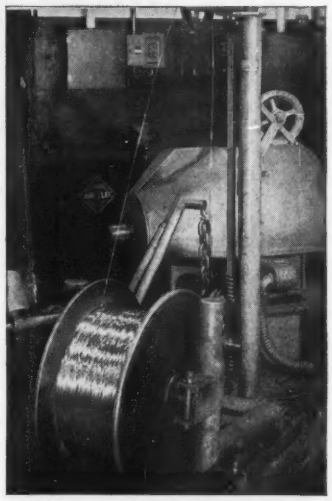

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## AC or DC Spooler Drives for Wire Enameling Equipment

(*Continued from page* 293)

relative costs of the various unregulated, adjustable voltage, wire enameling spooler drives as related to the cheapest drive, namely, the high torque induction AC motor.

★ ★ ★

**For** comparative analysis, the performance and the overall average winding deviation from Table 5 and cost relation as calculated on Table 6 are cross-plotted on Curve #13

★ ★ ★

**As** illustrated graphically in Curve 11 and tabulated in Table 1, it can be seen that percent winding deviation decreases and winding accuracy increases as cost increases with the various systems. The significant point is the high point which occurs with the DC series wound spooler in the middle of the cost curve. For a 10% increase in cost for a DC series wound spooler drive system, the winding performance can be expected to be about 50% better.

★ ★ ★

**Further** increases in cost of equipment result in significantly lower improvement in winding performance. The conclusion is drawn that the improvement in winding quality obtainable with a DC spooler drive system can be considerably greater in proportion to the increase in price necessary to obtain that improvement.

★ ★ ★

**This** discussion indicates in a rather general way the relation of performance in cost of winding equipment for wire enameling machinery. It is within the equipment builder's responsibility to analyze and present properly the performances of the various types of drives. It is, however, up to the equipment user to make the ultimate decision as to what kind of winding quality he wants in his machinery and he must be prepared to meet the additional cost of superior winding machines.

★ ★ ★

**Before** selecting any particular type of wire enameling drive, the


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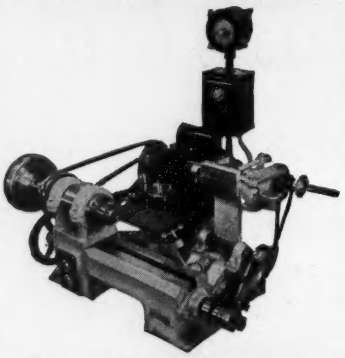

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equipment user should make a very thorough analysis of his operating conditions. This type of analysis will enable him to select the type of drive which will best meet his requirements and at the same time keep equipment costs to a minimum.

## Accurate Measuring of Insulated and Bare Wire—Its Importance and Techniques

(*Continued from page* 314)

by the fact that, at a wire speed of 2000 feet per minute, a three-second interval of counter reset during which no measuring occurs will let through 100 feet of unmeasured wire.

★ ★ ★

**Measuring** machines other than the two-wheel type are being built or have been built in the past. For continuous measurement of a specific diameter wire, a single wrap can be made around a wheel whose circumference is calibrated to a given wire length. This machine is, of course, limited to wire of one diameter, and is somewhat difficult to thread up.

★ ★ ★

**In** the single and double belt type machines, the wire drives a leather or fabric belt by pressure of the wire over a length of the belt. The belt, in turn, drives a measuring wheel. Although the introduction of the deformable belt between the wire and the wheel makes accuracy somewhat more difficult to obtain, recent developments have made it possible to build an accurate machine of this type.

★ ★ ★

**The** three-wheel type measuring machine, in which all three wheels are driven and expand equally to take varying wire diameters, is an accurate machine, and an excellent one for use on twisted pair wire, since bouncing of the wheels over the "hills and valleys" is less than in a two wheel machine. It has the disadvantage of being end-fed, however; the wire cannot be inserted laterally.

★ ★ ★

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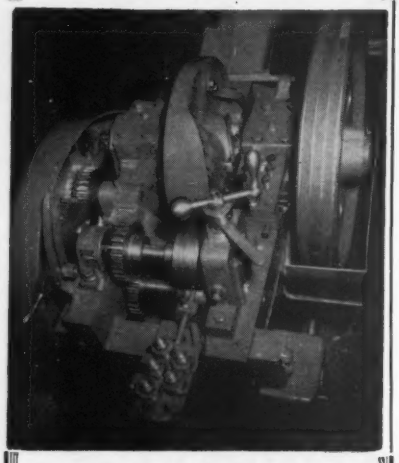

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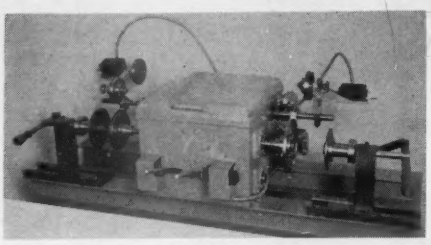

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ing machine for insulated wire:

1. **It should have two wheels, each about 18 inches in circumference.**
2. **Both wheels should drive the counter.**
3. **The wheels should be light in weight, with a hard, wear-resistant rim.**
4. **It should be possible to insert the wire from the side.**
5. **The wire should contact the wheels tangentially.**
6. **Wheel pressure on the insulation should be adjustable so that it can be set to somewhat near the minimum that will prevent slipping.**
7. **The machine should be able to handle a range of wire diameters up to about two inches.**
8. **The machine should be capable of driving one or more counters, and possibly a tachometer.**
9. **A simple stand should be provided for the machine, enabling it to be adjusted to wire-line height.**

### Measurement of Bare Wire

**While** emphasis in this article has been placed on the measurement of insulated wire, most of the principles mentioned can also be applied to measuring bare wire. Some wire mills have long realized the importance of accurate measurement, and many of them have invested in elaborate and expensive equipment to obtain it.

★ ★ ★

**For** bare wire measurement, the wheel surface should be of hardened steel, lightly knurled and possibly chrome-plated. The wheel pressure can be greater on bare wire, since no error due to deformation can occur. Usually this increased pressure is necessary to compensate for the lower coefficient of friction of bare wire. Except for this difference, the techniques for accurate measurement of bare wire are identical to those for insulated wire.

★ ★ ★

**An** example of the use to which a machine with a predetermining counter could be put in a wire drawing operation would be to signal a paint spray device that marks off the wire in desired lengths. This allows the coils to be cut and removed in equal lengths from the capstans.

★ ★ ★

**In** the stranding operation, the strand measurement requires a

laterally-inserted-wire type of machine that maintains a common centerline regardless of strand diameter. The best wheel design would include a hardened, knurled, and chrome-plated rim bonded by resilient rubber to the wheel hub. In stranding, accurate measurement is economically desirable to insure equal wire lengths on the supply reels.

★ ★ ★

**There** should be little doubt as to the need for efficient and accurate measurement of wire. Accuracy within 0.1 percent is obtainable. The difference between this figure and the accuracy now being obtained is the amount by which present manufacturing costs can be cut.

## Signal Corps Wire and Cable Symposium

(*Continued from page* 320)

nectors, good conductivity and ready assembly without the use of solder, with fewer varieties of connectors.

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**"Submarine** Cable System for the Florida Missile Test Range" by **Free Calhoun,** Air Force Missile Test Center, Patrick Air Force Base, Florida. Mr. Calhoun tells of a development of the Bell Telephone Laboratories undertaken for the Air Material Command to provide a multichannel carrier to meet the needs of observation stations testing guided missiles. The cable evolved embodied protection against laying stresses and the abrasion of ocean bottoms. So far, this cable has shown a high degree of reliability the cable structure and the system description were given.

★ ★ ★

**"Irrathene** 201 Irradiated Polyethylene" **by P. A. Goodwin,** Chemical Development Department, General Electric Co., Pittsfield Mass. This paper lists the good and poor qualities of polyethylene and shows how by irradiation, the good properties are retained and other desirable properties added—non-melting characteristics and resistance to stress cracking. Applications are to tapes, cloths and plastic film. The

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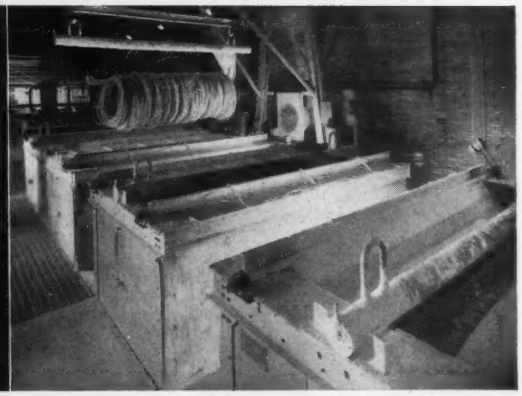

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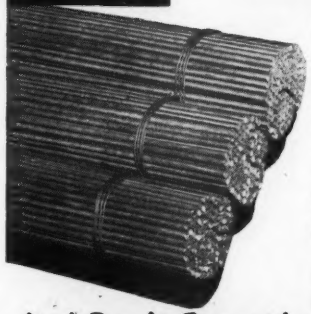

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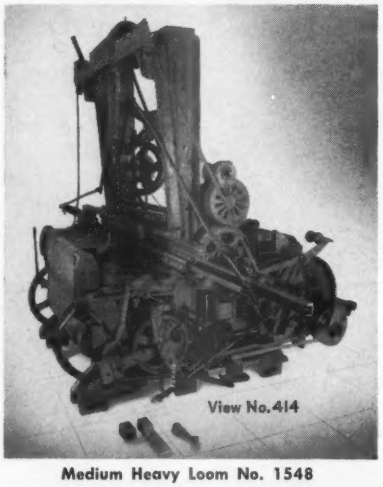
This loom has been redesigned and improved to provide better tension control. An electric automatic stop is furnished for when wire breakages occur. The looms are medium in weight. Approximately 16,000 lbs. for the 48" width and 18,000 lbs. for 60" widths. They are well-made, strong and rugged.

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**"The** Trans-Atlantic Telephone Cable" by **M. C. Biskeborne,** Bell Telephone Laboratories, Murray Hill, N. J. In this interesting paper the author noted the limitations of short wave radio systems and told why the Trans-Atlantic cable was needed for adequate and dependable. service. Earlier types of cable were described and the recent coaxial cable developments that overcome troubles to which they were subject. After covering the manner of laying cable on the ocean floor, Mr. Biskeborne presented some of the problems connected with the manufacture of the cables and repeaters.

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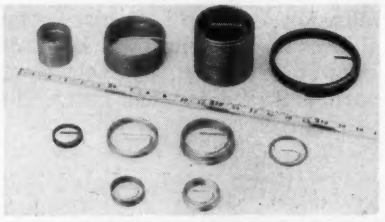

Variety of thread inserts.

**The** special large inserts have been formed up to 6-11/16" diameter with 12 threads per inch (not shown) to permit screwing replaceable cylinder liners into the cylinder block on the Packard marine diesel engine for easy, low-cost liner replacement.

★ ★ ★

**The** largest insert shown is 4-8

NPT (rear row-right) used in an aluminum casting. Note that the two inserts in the back row, second and third from the right, are both three inches in pitch diameter. The insert second from the right has six threads per inch and the one third from the right has 12 threads per inch. Both are used in automotive applications.

★ ★ ★

**In** the second row, second from the left, is shown an insert to provide 2″ pipe threads in a polyethylene plastic.

★ ★ ★

**Large** diameter inserts can be formed of wire from 3/16″ diameter down to a minimum of .015″ diameter.

★ ★ ★

**Although** the inserts shown are all N.C., N.F. or pipe threads, inserts of large pitch diameter can be formed in other thread series. Inserts for left-hand threads can be formed, as well as for double, triple or quadruple lead threads.

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The drawing of wire, bars, tubing, stampings, shells, shell cases, cold heading, and many other cold forming operations—including the cold extrusion of steel—are greatly facilitated by the application of a "Granodraw" zinc phosphate coating and a suitable lubricant prior to working.

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AMBLER, PA.
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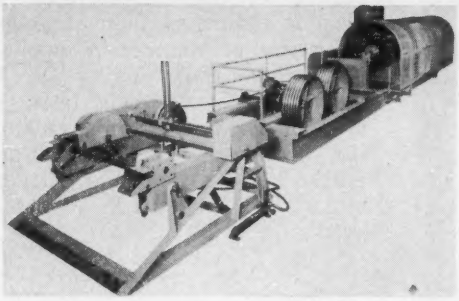
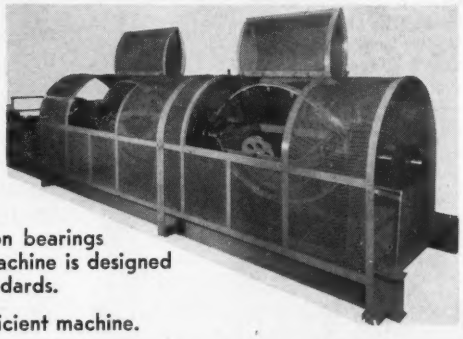
THREE-WIRE HEAVY DUTY TWISTING MACHINE



Built to handle wire from #14 to 500,000 circular mils in size on cradle reels.

Cradle reels either 30", 36" or 48" in diameter.

Rotor speeds from 800 r.p.m. to 30 r.p.m. controlled by gear box and dual drive.



Capstans either single with fleeter sheave as shown or double with diameters of 30", 36" or 42". Rates of lay from 1½" to 36".

Welded steel frame, anti-friction bearings and multiple roll guides. The machine is designed and built to our usual high standards.

An exceedingly versatile and efficient machine.

THE EDMANDS CO., 228 ABORN STREET PROVIDENCE 3, R. I.


**Specifications** for inserts in the large sizes conform to those in the standard sizes. Tolerances are held to .0002″ and surface finishes from 8-15 micro-inches can be produced. Hardness up to Rockwell 50C can be obtained in 18-8 stainless steel which is the standard material used. Inserts can be formed of phosphor bronze, Hastelloy "C", music wire (.75% C) and other metals.

### 1955 Condensed Reference File of Bakelite Plastics and Resins

**The** latest information about properties and uses of more than 50 Bakelite plastics and resins is easy to find in the new, revised reference file published by **Bakelite Company,** a Division of **Union Carbide and Carbon Corporation.**

★ ★ ★

**The** 12-page "1955 Condensed Reference File of Bakelite Plastics and Resins" presents short, accurate descriptions of the wide range of special and general-purpose Bakelite phenolic, vinyl, styrene, polyethylene, fluorothene, polyester, silicone, and epoxy plas-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and
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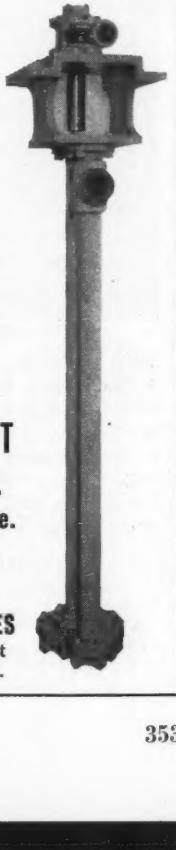

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Also available with rounded cutting edges for harder metals.

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Specialists in Metal Cutting Tools for over 75 years

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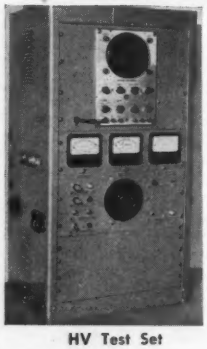
H. V. TEST SET with CORONA TEST FACILITIES (oil tank not shown)



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tics and resins, and Krene film and sheeting. The file contains essential information on the specific properties of these more than 50 plastics and resins, their particular industrial or commercial applications, and their ability to be molded, extruded, calendered or otherwise formed in manufacturing processes. Applications and finished products made of these materials are shown in 70 photographs.

★ ★ ★

**While** Bakelite Company does not supply finished plastic products, only unfinished resins and plastics, further information on any particular plastic can be readily obtained by writing to the nearest sales office listed in this booklet or to the company at 30 E. 42nd St., New York 17, N. Y.

## ACCO Announces Stronger Rope

A new high strength wire rope, at least 15 percent stronger than the best grade of wire rope now being manufactured, has been announced by the wire rope divisions of **American Chain & Cable Company,** Wilkes-Barre, Pa. Initial production will go to the construction, petroleum, mining, and logging fields.

★ ★ ★

**Representing** the most important change in the characteristics of wire in 35 years, the new grade of rope is expected to simplify the use of wire rope generally and to permit lighter weight equipment to be designed at lower cost. An average tensile strength of 300,000 psi has been achieved by the use of special precise analysis high carbon steel wire and improved processing.

★ ★ ★

**The** preformed rope, to be known as VHS—designating very high strength—will be manufactured by both the **Hazard Wire Rope** and **American Cable Divisions.** It has been widely tested in heavy-duty construction, mining, petroleum, and logging installations where its service life more than doubled that of existing

NEW THERMOPLASTIC
HOT-MELT FINISH
for
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Cleaner and better than asphalt. No black marks.

FLAME-PROOF
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**Send for details and investigate this fine finisher.**

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cables. Present diameters of the new product range from ½ inch to 2 inches.

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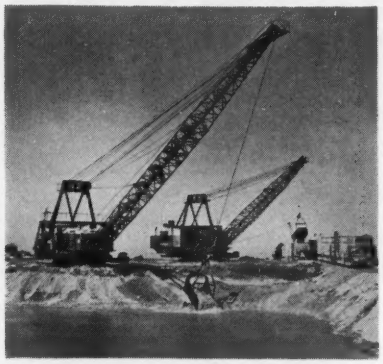
In addition to 15 percent greater



New drag line cable doubles service life. * *

tensile strength than improved plow steel, which has been the highest standard grade of the wire rope industry, VHS cable is more wear-resistant and will keep its shape under pressure. It has greater fatigue resistance than improved plow steel, is tougher, and resists plastic deformation or the tendency to become "hide bound." A special new lubricant is used which is designed to last for the life of the rope.

### New Wire and Cable Footage Recorder

**For** use in wire drawing, stranding, or insulating lines, a new machine by **Davis-Standard Sales Corporation,** 14 Water St., Mystic, Conn., accurately measures wire and cable footage at high speeds. It counts from zero to any preset limit, emits an electrical impulse, reverses itself, and counts back to zero. No wire count is lost during reset. This process is repeated automatically, without external reset, as long as is desired. At the end of each hlaf-cycle, the electrical signal sent out by the machine can be used to operate an audible or visible signal, to stop a take-up and pay-off combination, or to trigger the automatic reel cutover on a continuous take-up. Special hardened steel wheels are available for bare wire measurement.

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Wire manufacturers can be as-


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"Cuprodine" coats both carbon and stainless steels with a thin, bright, adherent layer of copper. This coating prolongs die life and improves the drawing of wire, rod and tubing.

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***Quality Guides***
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**Decreases down-time and replacement cost.**
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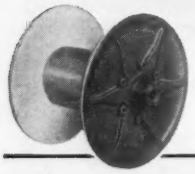
RUGGED in design... DEPENDABLE in service!

*Save on replacement and maintenance!*

**RUGGED STEEL HEAVY DUTY PROCESSING REELS**



Having trouble with light weight reels failing in heavy duty service? Send us a sketch or print stating the limiting dimensions and service required, we'll be glad to tell you about our facilities for supplying the wire rope and cable industry with special heavy duty processing reels, spools or bobbins. WRITE FOR BULLETIN 52-W.

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DESIGNERS – ENGINEERS – MANUFACTURERS
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ALL POWDERS CLEANED, ASSAYED AND GRADED TO MICRON SIZES.

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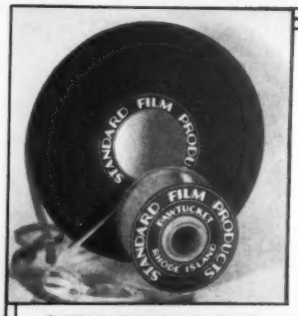


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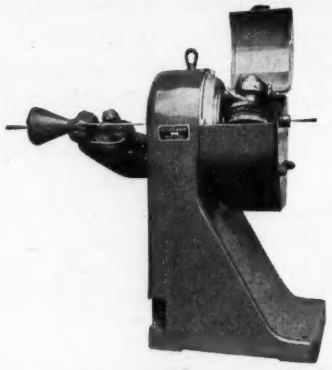
sured of wire counts that are accurate within 0.1 percent. The two large, 18-inch circumference measuring wheels are of light aluminum for low rotary inertia. Rims are coated with hardened steel for wear resistance. Measuring wheels are geared together so that both drive the counter. Adjustable spring loading of wheels provides light pressure for maximum accuracy with varying degrees of insulation hardness. Wire passes straight through machine, touching wheels only tangentially. Shafts of measuring wheels, gears, and guide sheave rotate in shielded ball bearings.

★ ★ ★

**This** measuring machine will handle wire speeds up to 2500 feet per minute, cables up to 2 inches in diameter. The maximum count for signal and automatic reversal is 80,000 feet. An accessory totalizing counter records the amount of wire passing through the machine over any desired time period.

**LINÉ-GORCY**
MECHANICAL
**WIRE ROD DESCALERS**
(Patented in U.S.A.)



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## Metal and Thermit Elects Vice President

**Metal & Thermit Corp.**, New York, has announced the election of **Richard O. Loengard** as vice president.

## Made Metal Buyer by Bohn

**Bohn Aluminum & Brass Corp.**, Detroit, has appointed **Louis Sirotkin** as metals buyer. He was formerly with Federated Metals Division, American Smelting & Refining Co.

## New Small Speed Reducer Announced

**Series** 11 Bantam Speed Reducers that have no backlash are now obtainable in Metron's Bantam Speed Reducer line. They are the same size and about the same weight as the standard Bantam units.

★ ★ ★

**Anti-backlash** results from two parallel gear trains that are spring loaded against each other — thus, backlash is continuously taken up whether running or not. The torsion spring is wound to give an anti-backlash torque of 2 lb.-inches either direction. Where maximum output torque isn't needed, spring torsion may be reduced to permit lower input torques.

★ ★ ★

**Ideal** for: flow controls, computers, timers, oscillographs. They may be obtained in any of 600 standard ratios. Gears are hobbed, 48 pitch and hardened to provide smooth operation and long life. Anti-friction bearings throughout.

★ ★ ★

**For** further details, write **Metron Instrument Co.**, 432 Lincoln St., Denver 3, Colo.

## Catalog on Forming and Fabricating Facilities

A new 12 page Catalog illustrating the stamping, drawing, forming and heading facilities of its Fabricatng Division is announced by **The Plume & Atwood Manu-**


**MUSIC WIRE and SPECIAL WIRES**

Music Wire for Industrial Purposes
211 sizes Bright Polished, .0015" to .3437"
45 sizes Bright Tinned, .003" to .125"
Aluminum—Annealed—Belt Lacing—Brass, Soft and Spring—Copper, Bare and Tinned
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Hoskins Chromel "A"—Stainless, Soft and Spring Temper—Tag Wire, 1000
in an Envelope—Florist Wire—Spooled and Coiled, 1/4-1/2-1-5#
Wires Straightened and Cut to length—Small Gauges—Small orders our specialty
Wires and Strands for the fishermen. Trolling Wires, Copper-Monel-Stainless.
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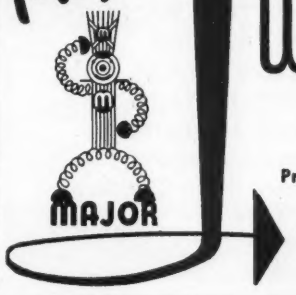
WE Major... IN PRECISION STRAIGHTENING

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**from .012 to .080**
YOUR STOCK OR WE WILL FURNISH
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DESIGNED FOR LONG LIFE AND MAXIMUM WIRE PRODUCTION
Furnished semi-finished to within .001" to .002" of finished size at rough-drilled die prices. Require only light sizing and polishing before using. Our dies embody special design features that make for superior performance.
Also, a full line of carbide tooling for the Cold Heading Industry
EASTERN CARBIDE CORPORATION
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**facturing Company,** Thomaston, Conn. P and A will shortly move into its new 150,000 square foot fabricating plant built to their specifications and located across the Naugatuck River from the P and A Rolling Mills. With additional stamping and forming equipment, its facilities will be among the most modern in the industry. The new management group under President **Thomas I. S. Boak** is fast bringing the old line firm into prominence as a metals fabricator and brass manufacturer.

★ ★ ★

**The** colorful new catalog also shows how by combining operations several items are now produced by P and A at substantial savings.

★ ★ ★

**The** catalog is available from the manufacturer, The Plume & Atwood Manufacturing Co., Thomaston, Conn.

## Durant Announces New Wire Measuring Machine

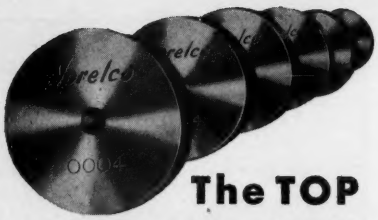
**The Durant Manufacturing Company,** of Milwaukee, Wisconsin, announces the addition of a new Wire Measuring Machine, the L-25 Series, to its line of counting and measuring devices. Of exceptionally rugged, durable construction, these units are designed for use by manufacturers and distributors of wire and wire rope.

★ ★ ★

A number of special features are incorporated in the L-25 Series, offering the user advantages not heretofore found in this type of counter. A lift and lock is placed on the top wheel to hold the wheel off the wire during set-up operation . . . a brake stops the measuring wheel instantly when the wire leaves the machine, assuring extreme accuracy of measurement. The wire is fed into the machine from a completely open side. This greatly increases the speed and ease of starting a new run of wire. The unit can be equipped with a Tackometer to register the rate of speed at which the wire is run.

★ ★ ★

**Standard** L-25 machines consist of the frame with one of four



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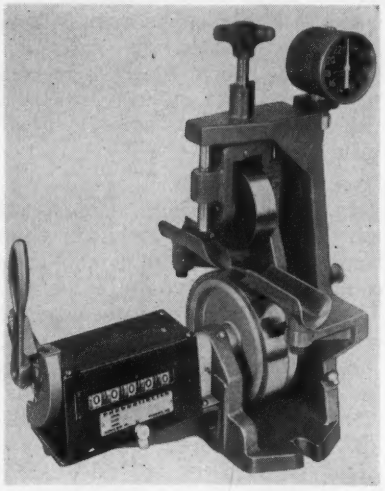
For your most exacting wire drawing requirements, standardize on NORELCO Diamond Dies, made by the master craftsmen of PHILIPS.

Only the very best South African and Brazilian diamonds are used. These are drilled to precision tolerances, varying in proportion to the diameter, normally 0.3 to 3.5 microns. Closer tolerances on request.

Let us quote on your diamond die requirements.

**North American Philips Company, Inc.**
**Elmet Division, Lewiston, Maine**


types of direct reading Productimeters: Model 5-HDW-7-1 with Wing Nut Reset or 5-HDW7-Q with Quick Lever Reset; and Predetermined Counters, Models 5-R-7-1 Wing Nut Reset, or 5-R-7-Q with Quick Lever Reset. Any of



Model L-25 Wire Measuring Machine with 5-R-7-Q Predeterminel Counter and Tachometer.

these can be furnished with the Tachometer, if desired.

★ ★ ★

**The** unit of measurement is in feet. The counter position may be on the right or left side, with rotation as top coming or top going. The Tachometer is on the right side only. Guides and Wheels are of hardened steel. Convenient mounting lugs are provided in the base. Overall dimensions are 12" x 10½" x 17"; approximate weight is 47 pounds.

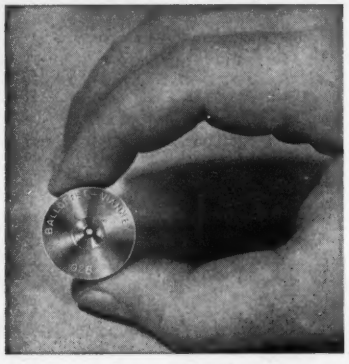
★ ★ ★

**Complete** information on the L-25 Series as well as other Productimeter Wire Measuring Machines, will be sent on request to the Durant Manufacturing Company, 1918 North Buffum Street, Milwaukee 1, Wisconsin.

## Shell and Tube Heat Exchangers for Cooling Applications

**Nocordal** shell and tube heat exchangers, manufactured by **Heil Process Equipment Corporation,** 12901 Elmwood Ave., Cleveland 11, Ohio, which have been used for many years for heating and cooling various acid solutions, have re-


**BALLOFFET VIANNEY WIRE DIE CO., Inc.**



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## Kenmore Metals Acquired By National Standard

**National Standard Company,** Niles, Mich., has acquired the operating assets of **Kenmore Metals Corporation,** Jersey City, N. J., and will operate the plant as its **Kenmore Metals Division.**

★ ★ ★

**Announcement** of the acquisition, to take effect immediately, was made by **W. H. Parkin,** chairman of the board of National Standard Company. According to Mr. Parkin, the new division was added to expand National Standard's line of non-corrosive and decorative finishes for their wire and wire products.

★ ★ ★

**Immediate** plans of the parent company call for continuing production of some of the products in the Kenmore plant, and in addition for granting licenses to other manufacturers. Included in the acquisition are the rights to continuous plating process for the electro-deposition of nickel, copper brass and other metals on ferrous and non-ferrous wire and tubing. Kenmore also has facilities for drawing and heat treating stainless steel wire.

★ ★ ★

**Mr.** Parkin reports that **Herbert Kenmore,** president of Kenmore, as well as other members of that organization, will remain active in the new division where they will operate under National Standard policies. Mr. Kenmore has been instrumental in initiating his firm's licensing program under its new plating patents — a program that

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★ ★ ★

**Most** recent previous addition was Reynolds Wire Division, Dixon, Ill. Other divisions include Athenia Steel division, Clifton, N. J., manufacturers of high carbon spring steel; Worcester Wire Works, Worcester, Mass., fine wire specialists; and Wagner Litho Machinery Division, Jersey City, N. J., manufacturers of metal decorating equipment.

## China's Wire Production

**Up** to now there has been only one plant in China producing wire and electric cable. This is a government electric wire plant in Shanghai, which by official reports produces over 300 kinds of cable and wire. In the last few years the plant has been modernized, so that today, besides common wire, power cable and street-car cable are manufactured. In the first six months of 1953 about 37,000 miles of cable and wire were produced. In 1954 this has been considerably increased. As part of the current 5-year plan another plant is included. This is already in process of erection in Mukden, and is planned to be larger than the Shanghai plant.

★ ★ ★

A good market for the wire industry is foreseen because of the intention to build up the electrical industry and construct new plants in the undeveloped provinces. Formerly China has imported her wire.

**From DRAHT-WELT, Nov. 10,1954**

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### DIES—Diamond
Ajax Industrial Supplies, Inc., Fort Wayne, Ind.
Balloffet-Vianney Wire Die Co., Inc., Guttenberg, N. J.
Boulin, Victor J., Inc., New York, N. Y.
Cochaud Wire Die Inc., New York, N. Y.
Ft. Wayne Wire Die, Inc., Fort Wayne, Ind.
Indiana Wire Die Co., Ft. Wayne, Ind.
Kelly Wire Die Corp., New York, N. Y.
National Wire Die Co., New York, N. Y.
New England Wire Die Co., Worcester, Mass.
**North American Philips Co., Inc., Elmet Div., Lewiston, Me.**
Rusch Wire Die Corp., Croton-on-Hudson, N. Y.
Union Wire Die Corp., New York, N. Y.
Universal Wire Die Co., Cranford, N. J.
Wayne Wire Die Co., Hillside, N. J.

### DIES DIAMOND—Reversible
National Wire Die Co., New York, N. Y.

### DIES—Extrusion
Carboloy Dept. of General Electric Co., Detroit.
Eastern Carbide Corp., New Rochelle, N. Y.
Firth Sterling, Inc., Pittsburgh, Pa.
Hontan Corporation, Yonkers, N. Y.
Metal Carbides Corporation, Youngstown, Ohio
Rusch Wire Die Corp., Croton-on-Hudson, N. Y.
Universal Wire Die Co., Cranford, N. J.
Wayne Wire Die Co., Hillside, N. J.

### DIES—Eyelet
**Eastern Carbide Corp., New Rochelle, N. Y.**

### DIES—Nail, Nail Cutters, Feeder Blocks, Grippers, etc.
Firth Sterling, Inc., Pittsburgh, Pa.
Pittsburgh Carbide Die Co., Monongahela, Pa.

### DIES—Pointing
Sjogren Tool and Machine Co., Auburn, Mass.

### DIES—Repairs & Re-Cutting
Ajax Industrial Supplies, Inc., Fort Wayne, Ind.
Balloffet-Vianney Wire Die Co., Inc., Guttenberg, N. J.
Boulin, Victor J., Inc, New York, N. Y.
Carboloy Dept. of General Electric Co., Detroit.
Cochaud Wire Die Inc., New York, N. Y.
Eastern Carbide Corp., New Rochelle, N. Y.
Ft. Wayne Wire Die., Inc., Fort Wayne, Ind.
Hontan Corporation, Yonkers, N. Y.
Indiana Wire Die Co., Ft. Wayne, Ind.
Kelloy Corporation, New York, N. Y.
Kelly Wire Die Corp., New York, N. Y.
Metal Carbides Corporation, Youngstown, Ohio
National Wire Die Co., New York, N. Y.
New England Wire Die Co., Worcester, Mass.
**North American Philips Co., Inc., Elmet Div., Lewiston, Me.**
Rusch Wire Die Corp., Croton-on-Hudson, N. Y.
Universal Wire Die Co., Cranford, N. J.
Vascoloy-Ramet Corp., Waukegan, Ill.
Wayne Wire Die Co., Hillside, N. J.

### DIES—Special Shapes, Etc.
Eastern Carbide Corp., New Rochelle, N. Y.
Firth Sterling, Inc., Pittsburgh, Pa.

# WHERE TO BUY, Continued

**For more complete information, consult the annual Wire and Wire Products Buyers' Guide.**

Hontan Corporation, Yonkers, N. Y.
**Indiana Wire Die Co., Ft. Wayne, Ind.**
Kelloy Corporation, New York, N. Y.
Union Wire Die Corp., New York, N. Y.

**DIES—Swaging**
Sjogren Tool and Mach. Co., Inc., Auburn, Mass.

**DIES—Tube Drawing**
Balloffet-Vianney Wire Die Co., Inc., Guttenberg, N. J.
Carboloy Dept. of General Electric Co., Detroit.
Eastern Carbide Corp., New Rochelle, N. Y.
Firth Sterling, Inc., Pittsburgh, Pa.
Hontan Corporation, Yonkers, N. Y.
Indiana Wire Die Co., Fort Wayne, Ind.
Kelloy Corporation, New York, N. Y.
Kelly Wire Die Corp., New York, N. Y.
Metal Carbides Corp., Youngstown, O.
Rusch Wire Die Corp., Croton-on-Hudson, N. Y
Vascoloy-Ramet Corp., Waukegan, Ill.

**DRAW BENCHES—**
(See MACHINERY—Draw Benches)

**DRUMS—Wire Packaging**
Continental Can Company, Van Wert, Ohio

**DRUMS & TRAVERSES—For Cable Reels**
Entwistle, James L., Co., Providence, R. I.
Hubbard Spool Co., Garrett, Ind.
New York Engineering Co., Yonkers, N. Y.
Republic Steel Corp., Pressed Steel Div., Niles, Ohio

**DRYING EQUIPMENT**
Carl-Mayer Corp., The, Cleveland, Ohio
Industrial Ovens, Inc., Cleveland, Ohio.
Rockwell, W. S. Co., Fairfield, Conn.

**ENGINEERS—Consulting**
Lubricants—Hans C. Bick, Inc., Reading, Pa.
Wire Mill—Clarence S. Arms, Worcester, Mass.
Zinc—Imhoff, Wallace G. Co., Los Angeles, Calif.

**EYELETS—Brass or Zinc**
Platt Bros. & Co., The, Waterbury, Conn.

**FENCING & FENCES—Wire**
Interlocking Fence Co., Morton, Ill.

**FILM—Insulating**
Standard Film Products Corp., Pawtucket, R. I.

**FOAM PRODUCING COMPOUNDS—**
American Chemical Paint Co., Ambler, Pa.
Parkin Chemical Co., The, Pittsburgh, Pa.

**FURNACES—Brazing**
Electric Furnace Co., Salem, Ohio
Rockwell, W. S. Co., Fairfield, Conn.

**FURNACES—Galvanizing Equipment**
Ajax Electric Co., Inc., Philadelphia, Pa.
Electric Furnace Co., Salem, Ohio
Rockwell, W. S. Co., Fairfield, Conn.
Surface Combustion Corp., Toledo, Ohio
Wilson, Lee, Engr. Co., Cleveland, Ohio

**FURNACES—Heat Treating**
Ajax Electric Co., Inc., Philadelphia, Pa.
Carl Mayer Corp., The, Cleveland, Ohio
Electric Furnace Co., Salem, Ohio
Drever Company, Phila., Pa.
Rockwell, W. S., Co., Fairfield, Conn.
Surface Combustion Corp., Toledo, Ohio
Wilson, Lee, Engr. Co., Cleveland, Ohio

**FURNACES—Lead Melting**
Electric Furnace Co., Salem, Ohio
Rockwell, W. S. Co., Fairfield, Conn.
Surface Combustion Corp., Toledo, Ohio

**FURNACES—Pot (oil, gas, electric)**
Ajax Electric Co., Inc., Philadelphia, Pa.

**FURNACES—Resistance Heating, Strand**
(See Annealing Machines)

**FURNACES—Salt Bath**
Ajax Electric Co., Inc., Philadelphia, Pa.
Electric Furnace Co., Salem, Ohio
Rockwell, W. S. Co., Fairfield, Conn.
Surface Combustion Corp., Toledo, Ohio

**GALVANIZING EQUIPMENT — (See MACHINERY—Galvanizing Wire)**

**GRINDERS—Roll**
Norton Co., The, Worchester, Mass.

**GUIDES—For Wire**
Heany Industrial Ceramic Corp., New Haven, Conn.

**GUIDE TIPS—For Extruding Machines (See NOZZLES)**

**HAMMERS—Nail Heading**
Firth Sterling, Inc., Pittsburgh, Pa.
Pittsburgh Carbide Die Co., Monongahela, Pa.

**HAMMERS—Swaging**
Sjogren Tool and Machine Co., Auburn, Mass.

**HARDSURFACING ALLOYS—**
(See Alloys—Hardsurfacing)

**HOOKS—Pickling & Liming**
Youngstown Welding & Eng'g' Co., Youngstown, Ohio

**HOISTS—Electric Travelling**
Cleveland Tramrail Div. of the Cleveland Crane & Engineering Co., Wickliffe, Ohio

**INHIBITORS—Pickling**
American Chemical Paint Co., Ambler, Pa.
Apex Alkali Products Co., Philadelphia, Pa.
Parkin Chemical Co., The, Pittsburgh, Pa.

**INSULATING MATERIALS—**
Carbro Chemical Company, Pawtucket, R. I.
Celanese Corporation of America, New York, N. Y.
Chemical Products Co., E. Providence, R. I.
Electronic Rubber Co., Stamford, Conn.
Pittsburgh Plate Glass Company, Pittsburgh, Pa.
Plymouth Cordage Company, Plymouth, Mass.
Standard Film Products Corp., Pawtucket, R. I.
Synthetic Thread Corporation, Bethlehem, Pa.

**INSULATING MATERIALS — Paper—For Electric Wire Cable**
Plymouth Cordage Company, Plymouth, Mass.

**LACQUERING SYSTEMS — See MACH.—Lacquering Electric Wire**

**LACQUERS—For Electric Wire**
Chemical Products Co., E. Providence, R. I.

**LAME—LAHN—**
Montgomery Co., The, Windsor Locks, Conn.

**LIME—**
Warner Co., The, Philadelphia and Bellefonte, Pa.

**LUBRICANTS — For Metal Cutting, Stamping and Drawing**
Apex Alkali Products Co., Philadelphia, Pa.
Magnuson Products Corporation, Brooklyn, N. Y.
Miller, R. H., Co., Inc., Homer, N. Y.
Nopco Chemical Co., Harrison, N. J.
Standard Industrial Compounds Co., Chicago.

**LUBRICANTS—Wire Drawing**
(See Compounds—Wire Drawing)

**LUBRICANTS—Wire Rope**
Swift & Co., Chicago, Ill.

**MACHINERY—Armoring (Cable, Wire, Hose)**
American Insulating Mach'y Co., Phila., Pa.
Sleeper & Hartley, Inc., Worcester, Mass.
Watson Machine Co., Paterson, N. J
Wire & Textile Mach'y, Inc., (used), Pawtucket, R. I.

**MACHINERY—Barbed Wire**
Glader Wm., Machine Works, Chicago, Ill.
Wafios, Maschinenfabrik, Reutlingen 3, Wurtt., Germany

**MACHINERY—Bobbin Winders**
Mummert-Dixon Company, Hanover, Pa.
Wire Equipment Mfg. Co., Trenton, N. J.

**MACHINERY—Braiding**
Fidelity Machine Co., Inc., Philadelphia, Pa.
New England Butt Co., Providence, R. I.
Wardwell Braiding Mach. Co., Central Falls, R. I.
Wire & Textile Mach'y, Inc. (used) Pawtucket, R. I.

**MACHINERY—Bunching**
Cook Manufacturing Co., The, Paterson, N. J.
Edmands Company, The, Providence, R. I.
Haskell-Dawes Machine Co., Philadelphia, Pa.
New England Butt Co., Providence, R. I.
Niehaus, K. A., Maschinenfabrik, Dusseldorf-Rath, Germany
Sleeper & Hartley, Inc., Worcester, Mass.
Watson Machine Co., Paterson, N. J.
Wire & Textile Mach'y, Inc. (used) Pawtucket, R. I.

**MACHINERY—Bundling, Scrap**
Sleeper & Hartley, Inc., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

**MACHINERY—Cable, Electric**
American Insulating Mach'y Co., Phila., Pa.
Fidelity Machine Co., Inc., Philadelphia, Pa.
Haskell-Dawes Machine Co. Philadelphia, Pa.
New England Butt Co., Providence, R. I.
New York Engineering Co., Yonkers, N. Y.
Niehaus, K. A., Maschinenfabrik, Dusseldorf-Rath, Germany
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

**MACHINERY—Capstans (See Machinery—Winding Wire)**

**MACHINERY—Centerless Grinding**
Schumag Schumacher Metallwerke, Aachen, Germany.

**MACHINERY—Chain Making**
Cosa Corporation, New York, N. Y.
Nilson, A. H. Machine Co., Bridgeport, Conn.
Wafios, Maschinenfabrik, Reutlingen 3, Wurtt., Germany

**MACHINERY—Closing Rope**
Niehaus, K. A., Maschinenfabrik, Dusseldorf-Rath, Germany
Watson Machine Co., Paterson, N. J.

**MACHINERY—Coiling Rod**
Vaughn Mach'y Co., Cuyahoga Falls, O.
Waterbury-Farrel Fdry. & Mach. Co., Waterbury, Conn.

**MACHINERY—Cold Heading**
Waterbury-Farrel Fdry. & Mach. Co., Waterbury, Conn.

**MACHINERY—Copper Wire Drawing**
Aetna-Standard Engineering Co., Pittsburgh.
American Insulating Mach'y Co., Phila., Pa.
National Mach'y Exch. (Used), New York.
Syncro Machine Co., Perth Amboy, N. J.
Torrington Mfg. Co., Torrington, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Fdry. & Mach. Co., Waterbury, Conn.

**MACHINERY—Covering Wire (See MACHINERY—Insulating Wire)**

**MACHINERY—Crimping Wire**
Cedar West Tool Co., New York, N. Y.

**MACHINERY—Cutting**
Lewis Machine Co., The, Cleveland, Ohio
Mettler Machine Tool, Inc., New Haven, Conn.
Wells, Frank L., Co., Kenosha, Wis.

**MACHINERY—Descaling Rod, Dry**
Fisher Associates, New York, N. Y.
Herborn, Herborn, Germany.

**MACHINERY—Die Making**
Boulin, Victor J., Inc., New York, N. Y.
Carboloy Dept. General Electric Co., Detroit, Mich.
Dykrex Corp., Roos Tool & Mfg. Div., Newark, N. J.
Firth Sterling, Inc., Pittsburgh, Pa.
Nord International Corporation, Orange, N. J.
Union Wire Die Corp., New York, N. Y.
Wayne Wire Die Co., Hillside, N. J.

**MACHINERY—Draw Benches**
Morgan Construction Co., Worcester, Mass.
Torrington Mfg. Co., Torrington, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.

**MACHINERY—Electrode Grinding**
Cosa Corporation, New York, N. Y.

**MACHINERY—Edging (See MACHINERY — Tandem Rolling and Edging Mills)**

**MACHINERY—Enameling**
American Insulating Mach'y Co., Phila., Pa.
Cook Manufacturing Co., The, Paterson, N. J.
Industrial Ovens, Inc., Cleveland, Ohio
Rockwell Co., W. S., Fairfield, Conn.

**MACHINERY—Extruding**
Aetna-Standard Engineering Co., Pittsburgh.
Davis-Standard Sales Corp., Mystic, Conn.
Entwistle, James L., Company, Providence, R. I.

# WHERE TO BUY, Continued

For more complete information, consult the annual Wire and Wire Products Buyers' Guide.

Modern Plastic Machinery Co., Lodi, N. J.
Royle, John, & Sons, Paterson, N. J.
Wire & Textile Mach'y, Inc. (used) Pawtucket, R. I.

**MACHINERY—Fence**
Blashill and Company, Arthur, Worcester, Mass.
Glader, Wm., Machine Works, Chicago, Ill.
Interlocking Fence Co., Morton, Ill.

**MACHINERY—Flat Wire**
Fenn Manufacturing Co., Newington, Conn.
Mettler Machine Tool, Inc., New Haven, Conn.
Torrington Mfg. Co., Torrington, Conn.

**MACHINERY—Forming Wire**
Baird Machine Co., Stratford, Conn.
Nilson, A. H., Machine Co., Bridgeport, Conn.
Wafios, Maschinenfabrik, Reutlingen 3, Wurtt., Germany

**MACHINERY—Fourdrinier Looms**
Cedar West Tool Co., New York, N. Y.

**MACHINERY—Galvanizing Wire**
Sleeper & Hartley, Inc., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.
Wilson, Lee, Engr. Co., Cleveland, Ohio

**MACHINERY—Gang Winders**
Entwistle, Jas. L. Co., Providence, R. I.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

**MACHINERY—Grinding**
Norton Co., The, Worcester, Mass.

**MACHINERY—Insulating Wire**
Aetna-Standard Engineering Co., Pittsburgh, Pa.
American Insulating Mach'y Co., Phila., Pa.
Davis-Standard Sales Corp., Mystic, Conn.
Fidelity Machine Co., Inc., Philadelphia, Pa.
Modern Plastic Machinery Company, Lodi, N. J.
New England Butt Co., Providence, R. I.
Pourtier Pere et Fils, Romainville (Seine), France
Royle, John & Sons, Paterson, N. J.
Syncro Machine Co., Perth Amboy, N. J.
Wardwell Braiding Macn. Co., Central Falls, R. I.
Watson Machine Co., Paterson, N. J.

**MACHINERY—Knitting**
Fidelity Machine Co., Inc., Philadelphia, Pa.

**MACHINERY—Lacquering Electric Wire**
American Insulating Mach'y Co., Philadelphia.
Cook Mfg. Co., The, Paterson, N. J.
Industrial Ovens, Inc., Cleveland, O.

**MACHINERY—Lock Washer**
Sleeper & Hartley, Inc., Worcester, Mass.

**MACHINERY—Looms, Wire Weaving**
Cedar West Tool Co., New York, N. Y.
Interlocking Fence Co., Morton, Ill.
Mummert-Dixon Co., Hanover, Pa.
Wafios, Maschinenfabrik, Reutlingen 3, Wurtt., Germany

**MACHINERY—Material Handling**
(See Material Handling Equipment)

**MACHINERY—Measuring Wire & Cable**
Durant Mfg. Co., Milwaukee, Wis.
Entwistle, James L., Company, Providence, R. I.
New England Butt Co., Providence, R. I.
Standard Mill Supply Co., Pawtucket, R. I.
Watson Machine Co., Paterson, N. J.

**MACHINERY—Nail and Tack**
Baird Machine Co., The Stratford, Conn.
Glader, Wm., Machine Works, Chicago, Ill.
National Mach'y Exch. (Used), New York, N. Y.
Seybold Transworld Exporters, New York, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.
Wafios, Maschinenfabrik, Reutlingen 3, Wurtt., Germany

**MACHINERY—Packaging Wire**
Coulter & McKenzie Machine Co., Bridgeport, Conn.

**MACHINERY—Pickling**
Chemsteel Construction Co., Pittsburgh, Pa.
Youngstown Welding & Eng'g Co., Youngstown, Ohio.

**MACHINERY—Pin Making**
Baird Machine Co., The, Stratford, Conn.
Cosa Corporation, New York, N. Y.

**MACHINERY—Pointing**
Aetna-Standard Engineering Co., Pittsburgh, Pa.
Morgan Construction Co., Worcester, Mass.
National Mach'y Exch. (Used). New York.
Scudder, E. J., Fdry. & Mach. Co., Trenton, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Foundry & Machine Co., Waterbury Conn.

**MACHINERY—Poultry Wire Fencing**
Interlocking Fence Co., Morton, Ill.

**MACHINERY—Pumps for Molten Metal**
Wire Equipment Mfg. Co., Trenton, N. J.

**MACHINERY—Re-Spooling**
Boyd & Sons Manufacturing Corp., Philadelphia, Pa.
Cedar West Tool Co., New York, N. Y.
Emory, Robert J., Co., Newark, N. J.
Mummert-Dixon Co., Hanover, Pa.
National Mach'y Exch. (Used), New York.
Utica Drop Forge & Tool Corp., Utica, N. Y.
Vaughn Machinery Co., Cuyahoga Falls, O.
Watson Machine Co., Paterson, N. J.
Wire Equipment Mfg. Co., Trenton, N. J.
Wire & Textile Mach'y, Inc. (used) Pawtucket, R. I.
Wire Insulating Machy., Div. of Machinery Electrification, Inc., Northboro, Mass.

**MACHINERY—Rod Mill**
Fenn Manufacturing Co., Newington, Conn.
Morgan Construction Co., Worcester, Mass.
Schumag Schumacher Metallwerke, Aachen, Germany

**MACHINERY—Rolling Mill**
Fenn Manufacturing Co., Newington, Conn.
Morgan Construction Co., Worcester, Mass.
Torrington Mfg. Co., Torrington, Conn.
Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.

**MACHINERY—Rubber Insulating**
Davis-Standard Sales Corp., Mystic, Conn.
Modern Plastic Machinery Co., Lodi, N. J.
Royle, John & Sons, Paterson, N. J.
Wire & Textile Mach'y, Inc. (used) Pawtucket, R. I.

**MACHINERY—Serving**
Fidelity Machine Co., Phila., Pa.
Pourtier Pere et Fils, Romainville (Seine), France
Wardwell Braiding Machine Co., Central Falls, R. I.

**MACHINERY—Spark Testing**
Entwistle, James L., Company, Providence, R. I.
Modern Plastic Machinery Co., Lodi, N. J.
Peschel Electronics, Inc., New Rochelle, N. Y.
Wire & Textile Mach'y, Inc. (used) Pawtucket, R. I.

**MACHINERY—Spring Making**
National Mach'y Exch. (Used), New York, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., Torrington, Conn.
Wafios, Maschinenfabrik, Reutlingen 3, Wurtt., Germany
Wells, Frank L., Co., Kenosha, Wisc.

**MACHINERY—Staple**
Seybold Transworld Exporters, New York, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.
Wafios, Maschinenfabrik, Reutlingen 3, Wurtt, Germany.

**MACHINERY—Straightening & Cutting**
Continental Fdy & Machine Co., Medart Division, Pittsburgh, Pa.
Cosa Corporation, New York, N. Y.
Lewis Machine Co., The, Cleveland, Ohio
Mettler Machine Tool Co., New Haven, Conn.
National Mach'y Exch. (Used), New York, N. Y.
Wells, Frank L., Co., Kenosha, Wisc.

**MACHINERY—Stranding**
Haskell-Dawes Machine Co., Philadelphia, Pa.
Milton Machine Works, Inc., Milton, Pa.
New England Butt Co., Providence, R. I.
Niehaus, K. A., Maschinenfabrik, Dusseldorf-Rath, Germany
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

**MACHINERY—Studmaking**
Cosa Corporation, New York, N. Y.

**MACHINERY—Swaging**
Fenn Manufacturing Co., Newington, Conn.
Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.

**MACHINERY—Take-Up and Pay-Out**
Aetna-Standard Engineering Co., Pittsburgh, Pa.
American Insulating Mach'y Co., Phila., Pa.
Blashill and Company, Arthur, Worcester, Mass.
Davis-Standard Sales Corp., Mystic, Conn.
Entwistle, James L., Company, Providence, R. I.
Fenn Manufacturing Co., Newington, Conn.
Industrial Ovens, Inc., Cleveland, Ohio
Modern Plastic Machinery Co., Lodi, N. J.
New York Engineering Co., Yonkers, N. Y.
Standard Mill Supply Co., Pawtucket, R. I.
Watson Machine Co., Paterson, N. J.
Wire Equipment Mfg. Co., Trenton, N. J.
Wire Insulating Machy., Div. of Machinery Electrification, Inc., Northboro, Mass.

**MACHINERY—Taping**
American Insulating Mach'y Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Pourtier Pere et Fils, Romainville (Seine), France
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.
Wire & Textile Mach'y, Inc. (used) Pawtucket, R. I.

**MACHINERY—Testing Magnet Wire Coatings for Pin Holes**
Peschel Electronics, Inc., New Rochelle, N. Y.

**MACHINERY—Testing, Physical**
Scott Testers, Inc., Providence, R. I.

**MACHINERY—Tinning Wire**
American Insulating Mach'y Co., Phila., Pa.
Cook Manufacturing Co., The, Paterson, N. J.
Syncro Machine Co., Perth Amboy, N. J.

**MACHINERY—Tinsel Rolling Mills**
American Insulating Mach'y Co., Phila., Pa.

**MACHINERY—Trolley Wire**
Torrington Mfg. Co., Torrington, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.

**MACHINERY—Tube Mill, Cold Drawing**
Aetna-Standard Engineering Co., Pittsburgh, Pa.
Mettler Machine Tool, Inc., New Haven, Conn.

**MACHINERY—Turks Head**
Fenn Manufacturing Co., Newington, Conn.

**MACHINERY—Twinning**
(See Mach.—Bunching)

**MACHINERY—Twisters, Wire**
Cook Manufacturing Co., The, Paterson, N. J.
Edmands Company, The, Providence, R. I.
Haskell-Dawes Machine Co., Philadelphia, Pa.

**MACHINERY—Used**
National Machinery Exchange, New York, N. Y.
Wire & Textile Machy., Inc., Pawtucket, R. I.

**MACHINERY—for Wire Welding**
(See WELDERS—Butt and Spot)

**MACHINERY—Washer Form'ng**
Cosa Corporation, New York, N. Y.

**MACHINERY—Welded Wire Fabric**
Maschinen & Stahl, A. G.,
Entwicklungs Verwertungs Gessellschaft Switzerland

**MACHINERY—Winding Wire**
Cedar West Tool Co., New York, N. Y.
Emory, Robert J., Newark, N. J.
Entwistle, James L., Company, Providence, R. I.
Fenn Manufacturing Co., Newington, Conn.
Mummert-Dixon Co., Hanover, Pa.
New England Butt Co., Providence, R. I.
Standard Mill Supply Co., Pawtucket, R. I.
Watson Machine Co., Paterson, N. J.
Wire Insulating Machy., Div. of Machinery Electrification, Inc., Northboro, Mass.

**MACHINERY—Wire Drawing**
Aetna-Standard Engineering Co., Pittsburgh, Pa.
Cook Manufacturing Co., The, Paterson, N. J.
Coulter & McKenzie Machine Co., Bridgeport, Conn.
Fenn Manufacturing Co., Newington, Conn.

# WHERE TO BUY, Continued

**For more complete information, consult the annual Wire and Wire Products Buyers' Guide.**

Herborn, Herborn, Germany
Morgan Construction Co., Worcester, Mass.
National Mach'y Exch. (Used), New York, N. Y.
Schumag Schumacher Metallwerke, Aachen, Germany
Scudder, E. J., Fdry. & Mach. Co., Trenton, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Vaughn Machinery Co., Cuyahoga Falls, Ohio
Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.

**MACHINERY—Wire Forming**
Baird Machine Co., The, Stratford, Conn.
Cosa Corporation, New York, N. Y.
National Mach'y Exch. (Used), New York, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.

**MACHINERY—Wire Rope**
Milton Machine Works, Inc., Milton, Pa.
New England Butt Co., Providence, R. I.
Niehaus, K. A., Maschinenfabrik, Dusseldorf-Rath, Germany
Watson Machine Co., Paterson, N. J.

**MACHINERY—Wrapping with Paper**
Terkelsen Machine Co., Boston, Mass.

**MATERIAL HANDLING EQUIPMENT—**
Cleveland Tramrail Div. of The Cleveland Crane & Engineering Co., Wickliffe, O.

**NAIL TOOLING—Tungsten Carbide**
Firth Sterling, Inc., Pittsburgh, Pa.
Pittsburgh Carbide Die Co., Monongahela, Pa.

**NAILS—Wire**
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Keystone Steel & Wire Co., Peoria, Ill.
Sheffield Steel Corp., Kansas City, Mo.
Wickwire Brothers, Inc., Cortland, N. Y.

**NOZZLES—For Extruding Machines**
Wire Tool Div., Bridgeport Jig Boring Co., Bridgeport, Conn.

**OVENS—Cable Lacquering**
American Insulating Mach'y Co., Phila, Pa.
Carl-Mayer Corp., The, Cleveland, Ohio
Industrial Ovens, Inc., Cleveland, Ohio
Rockwell Co., W. S., Fairfield, Conn.

**OVENS—Rod Bakers**
Carl-Mayer Corp., The, Cleveland, Ohio

**OVENS—Welding Rod Coating**
Carl-Mayer Corp., The, Cleveland, Ohio
Industrial Ovens, Inc., Cleveland, Ohio

**PAINT BONDING CHEMICALS—**
American Chemical Paint Co., Ambler, Pa.

**PAINTS—Heat Resisting**
American Chemical Paint Co., Ambler, Pa.

**PAPER—Creped Wrapping**
Arkell Safety Bag Company, New York, N. Y.
National Waterproof Papers, Inc., Beverly, N. J.
Terkelsen Machine Co., Boston, Mass.

**PAPER—For Coil Wrapping and Corrosion Prevention**
Arkell Safety Bag Company, New York, N. Y.
National Waterproof Papers, Inc., Beverly, N. J.
Terkelsen Machine Co., Boston, Mass.

**PAPER—Insulating**
Plymouth Cordage Co., Plymouth, Mass.

**PATENT ATTORNEYS—**
Lancaster, Allwine & Rommel, Washington, D. C.

**PAY-OUT SYSTEMS—**
(See MACHINERY—Take-Up & Pay-Out)

**PHOSPHATE COATING CHEMICALS**
(See COMPOUNDS—Phosphate Coating)

**PICKLING COMPOUNDS—**
See (Inhibitors—Pickling)

**PICKLING—Hooks, etc. Acid Resisting**
Youngstown Welding & Eng'g Co., Youngstown, Ohio

**PICKLING TANK LININGS—**
Chemsteel Construction Co., Pittsburgh, Pa.
Haveg Corp., Newark, Del.

**PIPES & FITTINGS—Acid Resistant**
Haveg Corp., Newark, Del.

**PLASTICS—for Wire Insulation**
Electronic Rubber Co., Stamford, Conn.

**POTS—Lacquer**
Industrial Ovens, Inc., Cleveland, Ohio

**PRESSES—Hydraulic and Mechanical**
Aetna-Standard Engineering Co., Pittsburgh, Pa.

**PULLERS AND GRIPS—For Wire**
Morgan Construction Co., Worcester, Mass.
Scudder, E. J. Fdry. & Mach. Co., Trenton, N. J.
Sjogren Tool and Machine Co., Auburn, Mass.
Sleeper & Hartley, Inc., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, Ohio

**PUMPS—Molten Metal**
Fisher Associates, New York, N. Y.

**REEL AND TENSION STANDS—**
Fidelity Machine Company, Inc., Philadelphia
Industrial Ovens, Inc., Cleveland, Ohio.
New York Engineering Co., Yonkers, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.
Standard Mill Supply Co., Pawtucket, R. I.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.
Wire Insulating Machy., Div. of Machinery Electrification, Inc., Northboro, Mass.

**REEL CRUTCHES—**
Watson Machine Co., Paterson, N. J.

**REELS & SPOOLS—Aluminum Alloy**
Acrometal Products, Inc., Minneapolis, Minn.
Hubbard Spool Co., Garrett, Ind.
Milton Machine Works, Inc., Milton, Pa.
Wardwell Braiding Machine Co., Central Falls, R. I.

**REELS & SPOOLS—Annealing and Stranding**
Acrometal Products, Inc., Minneapolis, Minn.
American Pulley Co., Philadelphia, Pa.
Apco Mossberg Co., Attleboro, Mass.
Hubbard Spool Co., Garrett, Ind.
Milton Machine Works, Inc., Milton, Pa.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Republic Steel Corp., Pressed Steel Div., Niles, Ohio

**REELS—Metal Bound**
Durkee Mfg. Co., Pine River, Minn.
Hubbard Spool Co., Garrett, Ind.
McCaskie, Inc., Wm., Westport, Mass.
Strand-Buffalo Corporation, North Tonawanda, N. Y.

**REELS—Plywood**
Hubbard Spool Co., Garrett, Ind.
McCaskie, Inc., Wm., Westport, Mass.
Nelson Company, The, Baltimore, Md.
Strand-Buffalo Corporation, North Tonawanda, N. Y.

**REELS & SPOOLS—Steel (All Types)**
Acrometal Products, Inc., Minneapolis, Minn.
American Pulley Co., Philadelphia, Pa.
Apco Mossberg Co., Attleboro, Mass.
Clark, J. L. Mfg. Co., Rockford, Ill.
Hubbard Spool Co., Garrett, Ind.
Mason Can Company, East Providence, R. I.
Milton Machine Works, Inc., Milton, Pa.
Mossberg Pressed Steel Corp., Attleboro, Mass.
New York Engineering Co., Yonkers, N. Y.
Republic Steel Corp., Pressed Steel Div., Niles, Ohio
Wardwell Braiding Machine Co., Central Falls, R. I.

**REELS—Wire Mill**
Acrometal Products, Inc., Minneapolis, Minn.
American Pulley Co., Philadelphia, Pa.
Apco Mossberg Co., Attleboro, Mass.
Bridge Mfg. Co., The, Hazardville, Conn.
Durkee Mfg. Co., Pine River, Minn.
Hubbard Spool Co., Garrett, Ind.
Mason Can Company, East Providence, R. I.
McCaskie, Inc., Wm., Westport, Mass.
Mettler Machine Tool, Inc., New Haven, Conn.
Milton Machine Works, Inc., Milton, Pa.
Mossberg Pressed Steel Corp., Attleboro, Mass.
New York Engineering Co., Yonkers, N. Y.
Republic Steel Corp., Pressed Steel Div., Niles, Ohio
Wardwell Braiding Machine Co., Central Falls, R. I.

**REELS & SPOOLS—Wooden**
American Woodworking Co., Chicago, Ill.
Bridge Mfg. Co., Inc., The, Hazardville, Conn.
Durkee Mfg. Co., Pine River, Minn.
Hubbard Spool Co., Garrett, Ind.
Nelson Company, The, Baltimore, Md.
Strand-Buffalo Corporation, North Tonawanda, N. Y.

**REFRACTORIES—High Temperature**
Norton Company, Worcester, Mass.

**ROD BAKERS—**
(See OVENS—Rod Bakers)

**RODS—Stainless Steel**
American Steel & Wire Co., Cleveland, Ohio
Crucible Steel Co. of America, Pittsburgh, Pa.
Pittsburgh Steel Co., Pittsburgh, Pa.

**RODS—Steel**
Crucible Steel Co. of America, Pittsburgh, Pa.

**RODS—Wire—Non-Ferrous**
Chase Brass & Copper Co., Waterbury, Conn.
Kaiser Aluminum & Chemical Corp., Oakland, Calif.
Platt Bros. & Co., The, Waterbury, Conn.
Scovill Mfg. Co., Waterbury, Conn.
Titan Metal Manufacturing Co., Bellefonte, Pa.

**RODS—Wire, Steel**
Bethlehem Steel Co., Bethlehem, Pa.
Colorado Fuel and Iron Corporation, Pacific Coast Division, Oakland, Calif.
Continental Steel Corp., Kokomo, Ind.
Crucible Steel Co. of America, Pittsburgh, Pa.
Keystone Steel & Wire Co., Peoria, Ill.
Pittsburgh Steel Co., Pittsburgh, Pa.
Sheffield Steel Corp., Kansas City, Mo.
Youngstown Sheet & Tube Co., Youngstown, O.

**ROPE—Blocks**
Madesco Tackle Block Co., Easton, Pa.

**ROPE—Wire**
American Steel & Wire Company, Cleveland, O.
Bethlehem Steel Co., Bethlehem, Pa.
Roebling's, John A. Sons Corp., Trenton, N. J.

**RUST PROOF COMPOUNDS—**
(See COMPOUNDS—Rust Preventing)

**RUST REMOVING COMPOUNDS—**
(See COMPOUNDS—Rust Preventing)

**SATURANTS—Cable**
Carbro Chemical Company, Pawtucket, R. I.

**SATURATION SYSTEMS—**
Industrial Ovens, Inc., Cleveland, Ohio
New York Engineering Co., Yonkers, N. Y.
Watson Machine Co., Paterson, N. J.
Wire & Textile Mach'y, Inc. (used) Pawtucket, R. I.

**SOAPS—Industrial and Wire Drawing**
(See COMPOUNDS—Wire Drawing)

**SPOOLS—(See Reels & Spools)**

**SPOOLS—Stamped Metal for Retail Wire Sales**
Clark, J. L. Mfg. Co., Rockford, Ill.
Mason Can Co., East Providence, R. I.

**STAMPINGS—Steel**
Acrometal Products, Inc., Minneapolis, Minn.
Mossberg Pressed Steel Corp., Attleboro, Mass.

**STRIP—Steel**
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
Roebling's, John A. Sons Corp., Trenton, N. J.
Youngstown Sheet & Tube Co., Youngstown, O.

**TANKS—Compound**
National Annealing Box Co., Washington, Pa.
New York Engineering Co., Yonkers, N. Y.
Watson Machine Co., Paterson, N. J.

**TANKS—Pickling and Plating**
Chemsteel Construction Co., Pittsburgh, Pa.
National Annealing Box Co., Washington, Pa.

**TESTERS — INSULATION**
(See MACHINERY—Spark Testers)

**TESTING EQUIPMENT**
(See MACHINERY Testing, Physical and Diameter Testing)

**TINNING PROCESS—**
Metal & Thermit Corp., New York, N. Y.

**TINSEL—Electric Conductor**
Montgomery Co., The, Windsor Locks, Conn.

**TINSEL WIRE—Resistance, Lame, Decorative Cords Thread—Bare Copper, Silver and False Gold Coated, etc.**
(See TINSEL—Electric Conductor)

**TOOLS—Die Cutting and Finishing**
Nord International Corporation, Orange, N. J.

# WHERE TO BUY, Continued

**For more complete information, consult the annual Wire and Wire Products Buyers' Guide.**

### TOOLS—Nail Machine
Pittsburgh Carbide Die Co., Monongahela, Pa.
Wire Equipment Mfg. Co., Trenton, N. J.

### TOOLS—Wire Cutting
Porter, H. K. Inc., Somerville, Mass.

### TRAMRAIL SYSTEMS—
Cleveland Tramrail Div. of the Cleveland Crane & Engineering Co., Wickliffe, O.

### TRANSMISSIONS—Variable speed (See Machy—Power Transmission)

### TRAVERSES & DRUMS—For Reels
(See Drums & Traverses)

### TRAVERSE MECHANISMS—
Apco Mossberg Co., Attleboro, Mass.
New England Butt Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.
Wire & Textile Mach'y, Inc. (used) Pawtucket, R. I.
Wire Insulating Machy., Div. of Machinery Electrification, Inc., Northboro, Mass.

### VALVES & FITTINGS—Acid Resistant
Haveg Corp., Newark, Del.

### VARNISHES & LACQUERS—for Electric Wire
Carbro Chemical Co., Pawtucket, R. I.
Chemical Products Co., E. Providence, R. I.

### VULCANIZING PANS AND EQUIPMENT—
American Insulating Mach'y Co., Phila., Pa.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Wire Insulating Machy., Div. of Machinery Electrification, Inc., Northboro, Mass.

### WELDERS—Spot and Butt
Maschinen & Stahl., A. G., Entwicklungs Verwertungs Gessellschaft Switzerland
Micro Products Co., Chicago, Ill.

### WIRE—Aluminum
Elmet Division, North American Philips Company, Inc., Lewiston, Maine
Kaiser Aluminum & Chemical Corp., Oakland, Calif.
Malin & Co., The, Cleveland, Ohio
National Standard Company, Niles, Mich.
Scovill Mfg. Co., Waterbury, Conn.

### WIRE—Barbed
Interlocking Fence Co., Morton, Ill.
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.

### WIRE—Brass
Chase Brass & Copper Co., Waterbury, Conn.
Scovill Mfg. Co., Waterbury, Conn.
Spencer Wire Corp., Union, N. J.
Titan Metal Manufacturing Co., Bellefonte, Pa.

### WIRE—Brush
Spencer Wire Corp., Union, N. J.

### WIRE—Bunched & Stranded, Copper
Camden Wire Co., Camden, N. Y.

### WIRE—Cast
Youngstown Sheet & Tube Co., Youngstown, O.

### WIRE—Cold Heading
American Steel & Wire Co., Cleveland, Ohio
Bethlehem Steel Co., Bethlehem, Pa.
Camden Wire Co., Camden, N. Y.
Chase Brass & Copper Co., Waterbury, Conn.
Colorado Fuel and Iron Corporation, Pacific Coast Division, Oakland, Calif.
Continental Steel Corp., Kokomo, Ind
Crucible Steel Co. of America, Pittsburgh, Pa.
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
Kaiser Aluminum & Chemical Corp., Oakland, Calif.
Keystone Steel & Wire Co., Peoria, Ill.
Pittsburgh Steel Co., Pittsburgh, Pa.
Scovill Mfg. Co., Waterbury, Conn.
Sheffield Steel Corp., Kansas City, Mo.
Titan Metal Manufacturing Co., Bellefonte, Pa.
Wickwire Steel Div., The Colorado Fuel & Iron Corp., New York, N. Y.
Youngstown Sheet & Tube Co., Youngstown, O.

### WIRE—Copper
Chase Brass & Copper Co., Waterbury, Conn.
Spencer Wire Corp., Union, N. J.

### WIRE—For Electrical Conductors
Camden Wire Co., Camden, N. Y.
Kaiser Aluminum & Chemical Corp., Oakland, Calif.

### WIRE—Flat, Fine
Elmet Division, North American Philips Company, Inc., Lewiston, Maine
Montgomery Co., The, Windsor Locks, Conn.

### WIRE—Galvanized
Colorado Fuel and Iron Corporation, Pacific Coast Division, Oakland, Calif.
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
National Standard Company, Niles, Mich.
Roebling's, John A. Sons Corp., Trenton, N. J.
Sheffield Steel Corp., Kansas City, Mo.
Wickwire Steel Div., Colorado Fuel & Iron Corp., New York, N. Y.

### WIRE—Manufacturers
American Steel & Wire Co., Cleveland, Ohio
Bethlehem Steel Co., Bethlehem, Pa.
Chase Brass & Copper Co., Waterbury, Conn.
Colorado Fuel and Iron Corporation, Pacific Coast Division, Oakland, Calif.
Continental Steel Corp., Kokomo, Ind.
Crucible Steel Co. of America, Pittsburgh, Pa.
Johnson Steel & Wire Co., Inc., Worcester, Mass.
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
Kaiser Aluminum & Chemical Corp., Oakland, Calif.
Keystone Steel & Wire Co., Peoria, Ill.
National Lock Washer Company, The, Newark, N. J.
North American Philips Co., Inc., Elmet Division, Lewiston, Me.
Pittsburgh Steel Co., Pittsburgh, Pa.
Roebling's, John A., Sons Corp., Trenton, N. J.
Scovill Mfg. Co., Waterbury, Conn.
Sheffield Steel Corp., Kansas City, Mo.
Spencer Wire Corp., Union, N. J.
Titan Metal Manufacturing Co., Bellefonte, Pa.
U. S. Steel Corp., N. Y., N. Y.
Wickwire Brothers, Inc., Cortland, N. Y.
Wickwire Steel Div., Colorado Fuel & Iron Corp., New York, N. Y.
Youngstown Sheet & Tube Co., Youngstown, O.

### WIRE—Music
American Steel & Wire Co., Cleveland, Ohio
Johnson Steel & Wire Co., Inc., Worcester, Mass.
Malin & Co., The, Cleveland, Ohio
Spencer Wire Corp., Union, N. J.

### WIRE—Needle
Carpenter Steel Company, Webb Wire Division, New Brunswick, N. J.

### WIRE—Nickel Silver and Phosphor Bronze
Alloy Metal Wire Div., H. K. Porter Co., Inc., Pittsburgh, Pa.
Chase Brass & Copper Co., Waterbury, Conn.
Malin & Co., The, Cleveland, Ohio
Titan Metal Manufacturing Co., Bellefonte, Pa.

### WIRE—Oil Tempered
Crucible Steel Co. of America, Pittsburgh, Pa.
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
Pittsburgh Steel Co., Pittsburgh, Pa.
Roebling's, John A., Sons Corp., Trenton, N. J.
Sheffield Steel Corp., Kansas City, Mo.

### WIRE—Silver Plated Copper
Camden Wire Co., Camden, N. Y.

### WIRE—Special Shapes
Alloy Metal Wire Div., H. K. Porter Co., Inc., Pittsburgh, Pa.
Crucible Steel Co. of America, Pittsburgh, Pa.
Continental Steel Corp., Kokomo, Ind.
National Lock Washer Company, The, Newark, N. J.
Titan Metal Manufacturing Co., Bellefonte, Pa.

### WIRE—Spring
Alloy Metal Wire Div., H. K. Porter Co., Inc., Pittsburgh, Pa.
Bethlehem Steel Co., Bethlehem, Pa.
Colorado Fuel and Iron Corporation, Pacific Coast Division, Oakland, Calif.
Continental Steel Corp., Kokomo, Ind.
Crucible Steel Co. of America, Pittsburgh, Pa.
Johnson Steel & Wire Co., Inc., Worcester, Mass.
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
Keystone Steel & Wire Co., Peoria, Ill.
National Standard Company, Niles, Mich.
Pittsburgh Steel Co., Pittsburgh, Pa.
Roebling's, John A., Sons Corp., Trenton, N. J.
Sheffield Steel Corp., Kansas City, Mo.
Wickwire Steel Div., Colorado Fuel & Iron Corp., New York, N. Y.
Youngstown Sheet & Tube Co., Youngstown, O.

### WIRE—Stainless Steel
American Steel & Wire Co., Cleveland, Ohio
Carpenter Steel Company, Webb Wire Div., New Brunswick, N. J.
Crucible Steel Co. of America, Pittsburgh, Pa.
Firth Sterling, Inc., Pittsburgh, Pa.
Major Co., J., Chicago, Ill.
National Lock Washer Company, The, Newark, N. J.
National Standard Company, Niles, Mich.
Pittsburgh Steel Co., Pittsburgh, Pa.

### WIRE—Steel—Also Coppered and Galvanized Steel
Alloy Metal Wire Div., H. K. Porter Co., Inc., Pittsburgh, Pa.
Bethlehem Steel Co., Bethlehem, Pa.
Colorado Fuel and Iron Corporation, Pacific Coast Division, Oakland, Calif.
Continental Steel Corp., Kokomo, Ind.
Crucible Steel Co. of America, Pittsburgh, Pa.
Johnson Steel & Wire Co., Inc., Worcester, Mass.
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
Keystone Steel & Wire Co., Peoria, Ill.
Major Co., J., Chicago, Ill.
National Standard Company, Niles, Mich.
Pittsburgh Steel Co., Pittsburgh, Pa.
Roebling's, John A., Sons Corp., Trenton, N. J.
Sheffield Steel Corp., Kansas City, Mo.
Spencer Wire Corp., Union, N. J.
U. S. Steel Export Co., New York, N. Y.
Wickwire Brothers, Inc., Cortland, N. Y.
Wickwire Steel Div., Colorado Fuel & Iron Corp., New York, N. Y.
Youngstown Sheet & Tube Co., Youngstown, O

### WIRE—Straightening and Cutting
Colorado Fuel and Iron Corporation, Pacific Coast Division, Oakland, Calif.
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
Major Co., J., Chicago, Ill.
Wickwire Brothers, Inc., Cortland, N. Y.
Wickwire Steel Div., Colorado Fuel & Iron Corp., New York, N. Y.

### WIRE—Tinned Copper
Camden Wire Co., Camden, N. Y.

### WIRE—Tungsten
North American Philips Co., Inc., Elmet Division, Lewiston, Me.

### WIRE—Zinc
Platt Bros. & Co., The, Waterbury, Conn.

### WRAPPING PAPER—Creped
(See PAPER—Creped Wrapping)

### YARNS & TAPES—Insulating
Celanese Corporation of America, New York, N. Y.
Pittsburgh Plate Glass Company, Pittsburgh, Pa.
Standard Film Products Corp., Pawtucket, R. I.
Synthetic Thread Corporation, Bethlehem, Pa.

### YARN TESTERS—
Scott Testers, Inc., Providence, R. I.


***Now is a good time to join* THE WIRE ASSOCIATION**

**All persons engaged in the production of wire, wire products and electric wire and cable should be members and participate in its good work.**

**453 MAIN STREET** **RICHARD E. BROWN, *Executive Secretary*** **STAMFORD, CONN.**

# The WATSON MACHINE COMPANY

ESTABLISHED 1845

**PATERSON 3, NEW JERSEY, U. S. A.**

ELECTRICAL WIRE AND CABLE, WIRE ROPE, CORDAGE AND MASTICATING MACHINERY MANUFACTURERS

WATSON

**PLANETARY STRANDERS.** Three types, many sizes, for all duties, geared or ring backturn, main rotor shaft or roller support. "Shaftless" cradles.

**RIGID FRAME STRANDERS "RH."** Horizontal, overhung spindle designs. Ball bearing main rotor shaft support, no support rollers.

**TUBULAR STRANDERS "TH."** High speed type in all sizes. Patented Boat cradles and Tungsten Carbide guide system. Rotor and layhead electric stops.

**TUBULAR STRANDERS "VL."** New design, safe extra high speeds. Quick loading. "Shaftless" no loose parts cradles.

**CABLERS.**

Planetary and high speed "HH" designs.

**CLOSERS.**

Planetary and high speed types for wire rope.

WATSON

**BUNCHERS.**

VERTICAL Minimum Floor Space Double-Twist Types "V-7" 250 # Cap. V-10 500 & 1000 # Cap.

**ARMORING MACHINES.** Complete with planetary wire or metal tape heads.

**JUTERS.** 36 or 48 cop and to 6-inch cable passage.

**SERVING HEADS.** Concentric and eccentric, many designs, for threads, asbestos, etc.

**TAPING HEADS.** Many types and sizes. For metallic and non-metallic tapes. Eccentric, single and double-concentric. Patented uniform torque tape brake.

**COMPOUNDING AND SATURATING TANKS.** Many types and sizes.

**CHALK, MICA AND OTHER POWDER APPLIERS.** "Wet and Dry" types in a variety of designs and sizes.

**CAPSTAN SECTIONS.** Single tapered wheels to 10 foot dia. with standard single or double shoe, or ball bearing ring fleeters. Double grooved types to 96 inch dia. For heaviest duty and highest haul pulls. Many sizes and designs.

**TRACTOR CAPSTANS.** Available in two types with sizes to suit many applications.

**LET-OFF.** Manual, mechanical, hydraulic, and electric motor lift types and "shaftless" designs to 120-inch 30-ton sizes.

**GANG SPOOLERS.** Table and Floor types in many sizes and designs.

**REWINDERS AND COILERS.** All motorized, for warehouse and shipping use.

**CAPSTAN TAKEUPS.** Single and in multiples.

**HEAVY DUTY TAKEUPS.** "Shaftless" in many designs and sizes to 120"-50-ton. Mechanical lift, hydraulic lift, motorized lift, incline frame, and other types. Line shaft, electric, and hydraulic drives. Foot treadle, electric switch, pneumatic, hydraulic, and mechanical controls.

**CONTINUOUS TAKEUPS.** Double reel designs, constant tension, wide speed range to cover all Continuous Vulcanizing and plastic Extruding takeup requirements.

**TAKEUP TRANSMISSIONS.** Heavy Duty, Type "D." Combines two-speed transmission, manual slack-takeup drive, and multiple-disc-in-oil friction mechanism in one compact unit. Now available in three sizes.

**AUTOMATIC TRAVERSES.** Many sizes and arrangements. Wide lay range. Designs cover range from fine wire to 6" cable and wire rope. Fully automatic and disconnectible for manual operation. Suitable and widely used for replacement of inadequate mechanism on older takeups.

**VULCANIZERS.** Cavity and Plate "Patch" units. Mechanically or pneumatically operated. Available with or without dies.

**MOLDED SHEAVES.** Low cost, light weight Bakelite sheaves 11" O.Dia. x 8" groove Dia. Available in a variety of colors.

**TESTING MACHINES.** Impact, Torsion, Bend and Endurance types.

**MEASURING MACHINES.** For linear measurement. Offered in a variety of sizes and arrangements.

**REEL CRUTCHES.** For turning very large and heavy reels. Widely used in warehouses, shipping rooms, by railroads, steamship lines and wherever reel handling is a problem. Available from stock.

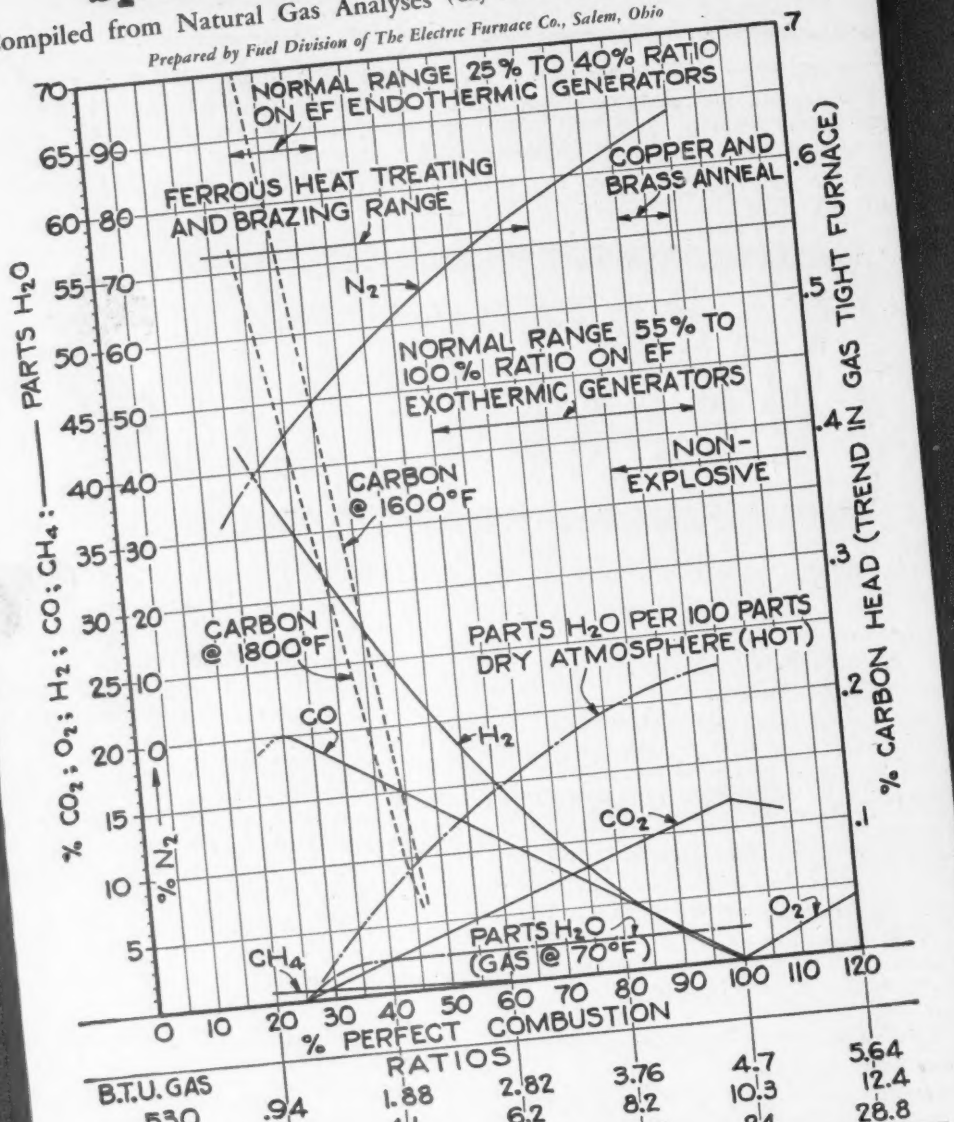
**CABLE PLANT AND WIRE ROPE MILL EQUIPMENT.** All manners of special and miscellaneous designs for general and special purpose work too numerous for listing but on which inquiries are invited.

3-55

# Special Atmosphere Chart

Compiled from Natural Gas Analyses (City Gas and Propane Gas will be similar)

*Prepared by Fuel Division of The Electric Furnace Co., Salem, Ohio*


NORMAL RANGE 25% TO 40% RATIO ON EF ENDOTHERMIC GENERATORS
FERROUS HEAT TREATING AND BRAZING RANGE
COPPER AND BRASS ANNEAL
$N_2$
NORMAL RANGE 55% TO 100% RATIO ON EF EXOTHERMIC GENERATORS
NON-EXPLOSIVE
CARBON @ 1600°F
CARBON @ 1800°F
PARTS $H_2O$ PER 100 PARTS DRY ATMOSPHERE (HOT)
CO
$H_2$
$CO_2$
$O_2$
PARTS $H_2O$ (GAS @ 70°F)
$CH_4$
% $CO_2$ ; $O_2$ ; $H_2$ ; CO ; $CH_4$ ; —— PARTS $H_2O$
% $N_2$
% CARBON HEAD (TREND IN GAS TIGHT FURNACE)
% PERFECT COMBUSTION
RATIOS

| B.T.U. GAS | | | | | | |
|---|---|---|---|---|---|---|
| 530 | .94 | 1.88 | 2.82 | 3.76 | 4.7 | 5.64 |
| 1030 | 2 | 4.1 | 6.2 | 8.2 | 10.3 | 12.4 |
| 2550 | 4.8 | 9.6 | 14.4 | 19.2 | 24 | 28.8 |

Above percentages on gas atmosphere constituents have been averaged from many complete gas analyses. Actual gas analyses compared with above curves will vary slightly due to differences in generator temperature, catalyst, completeness of reaction, raw gas analysis and air-fuel ratio.

Carbon head determinations are obtained by running .001"x2"x2" carbon steel specimens, of high and low carbon, through a gas tight furnace. After exposure to gas atmosphere in furnace for at least twenty minutes (or until equilibrium is reached) the specimens are analyzed for carbon in chemical laboratory carbon furnace. About 8 specimens are required for one chemical analysis.

For special atmosphere generators and furnaces for bright annealing, scale-free hardening, brazing, carbon restoration, gas carburizing, sintering, normalizing, malleablizing, billet heating, heating for forging or equipment for any other industrial heating or heat treating process, consult

**THE ELECTRIC FURNACE CO.** **SALEM, OHIO**

*Designers and Builders of*

Gas Fired, Oil Fired and Electric Furnaces.

Special Atmosphere Generators and Other Auxiliary Equipment

**Additional Charts** for note books or larger size for wall use gladly furnished by The Electric Furnace Co.